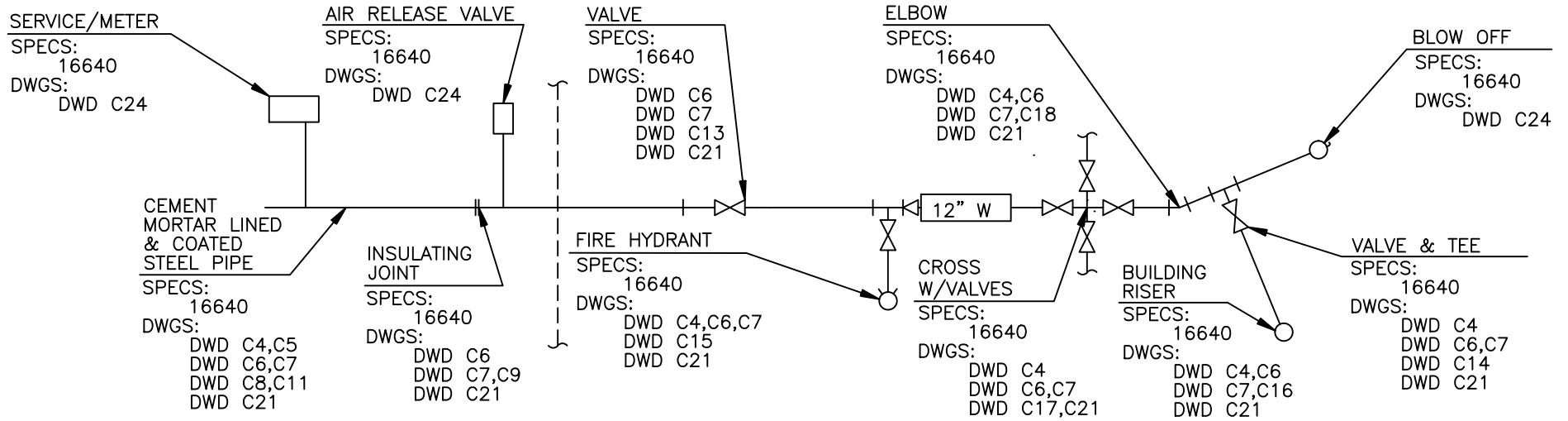


7. Cathodic Protection

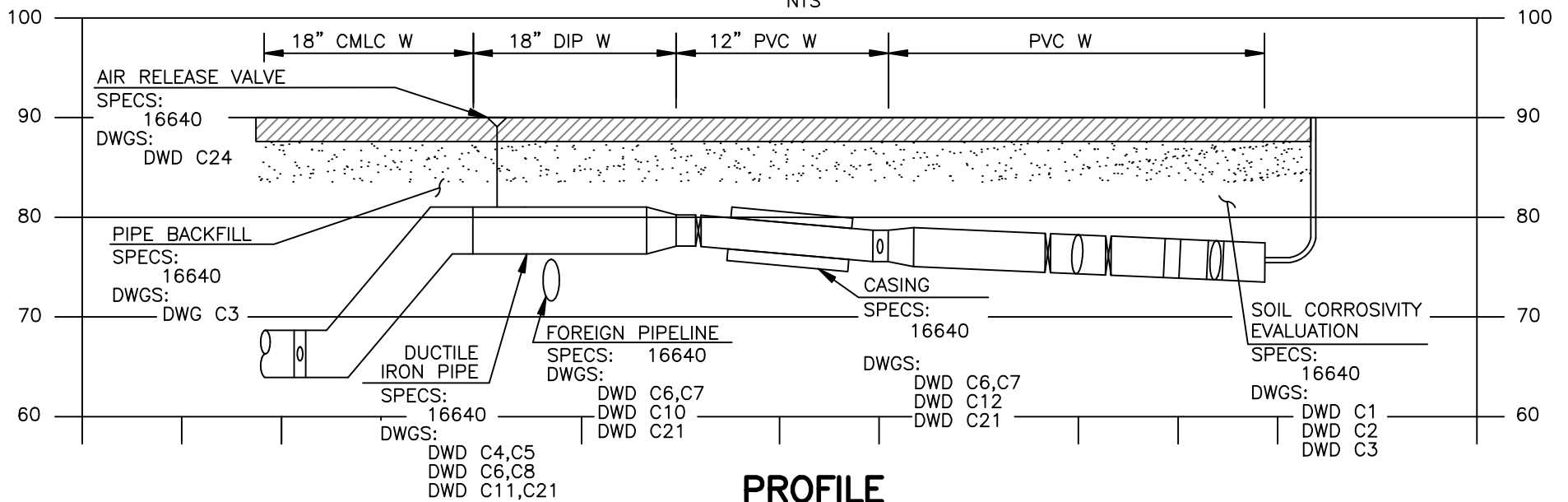
**DIABLO WATER DISTRICT
STANDARD SPECIFICATIONS AND DRAWINGS**

CATHODIC PROTECTION SYSTEM DRAWINGS

| | |
|---------|---|
| DWD C1 | Wenner Four Pin Resistivity Test |
| DWD C2 | Barnes Layer Resistivity |
| DWD C3 | Soil Box Resistivity Test |
| DWD C4 | Bond Cables – Metallic Pipe Joints |
| DWD C5 | Bond Cables – Across Fittings on Metallic Pipe |
| DWD C6 | Exothermic Weld |
| DWD C7 | Flush Grade Test Station |
| DWD C8 | CTS – Corrosion Test Station |
| DWD C9 | IJS – Insulating Joint Test Station |
| DWD C10 | FPTS – Foreign Pipeline Test Station |
| DWD C11 | ATS – Anode Test Station |
| DWD C12 | CATS – Casing Test Station |
| DWD C13 | VATS – Valve Anode Test Station |
| DWD C14 | Valve and Tee Anode Test Station |
| DWD C15 | Fire Hydrant |
| DWD C16 | Metallic Riser |
| DWD C17 | Cross and Valves |
| DWD C18 | Elbow |
| DWD C19 | Double Detector Check Assembly Preventer or Reduced Pressure Backflow Preventer |
| DWD C20 | Double Offset |
| DWD C21 | Cable Identification |
| DWD C22 | Anode at Leak Repair Clamp |
| DWD C23 | Insulating Flange Kit |
| DWD C24 | Copper Water Laterals |
| DWD C25 | Splice Detail |
| DWD C26 | Galvanic Cathodic Protection System Checkout |
| DWD C27 | Impressed Current Cathodic Protection System Checkout (page 1) |
| DWD C28 | Impressed Current Cathodic Protection System Checkout (page 2) |
| DWD C29 | Leak Repair Report |



PLAN
 NTS



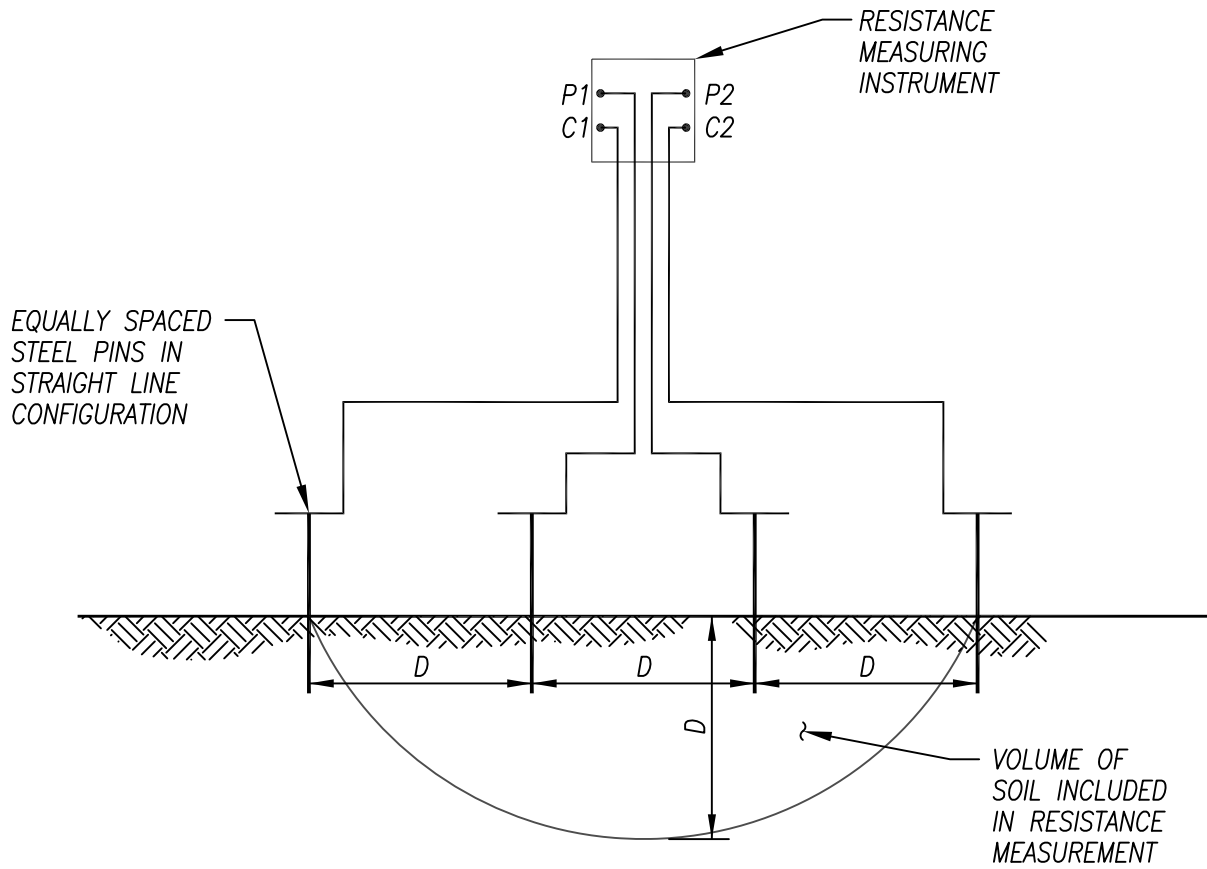
PROFILE
 NTS

DIABLO WATER DISTRICT

STANDARD DRAWING

QUICK REFERENCE GUIDE – CATHODIC PROTECTION

DESIGNED MA DRAWN TH/JAW APPROVED MY DATE DECEMBER 2013 DWG. NO. DWD CO



WHERE D=SAMPLE DEPTH.

DIABLO WATER DISTRICT

STANDARD DRAWING
WENNER FOUR PIN RESISTIVITY TEST

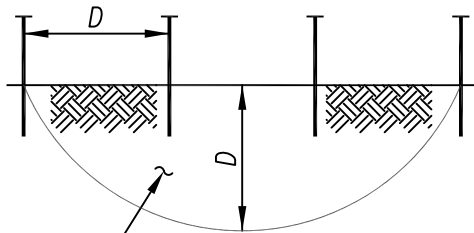
DESIGNED MA

DRAWN SC

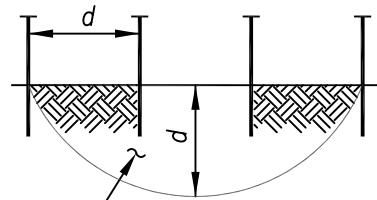
APPROVED JDH

DATE DECEMBER 2013

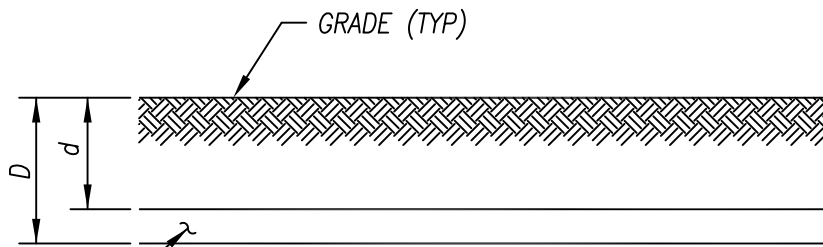
DWG. NO. DWD C1



VOLUME OF SOIL
WITH RESISTANCE R
AND RESISTIVITY RHO



VOLUME OF SOIL
WITH RESISTANCE r
AND RESISTIVITY rho



LAYER OF SOIL
WITH RESISTIVITY = $\left(\frac{1}{\frac{1}{R} - \frac{1}{r}} \right) \times (\text{SPACING FACTOR})$

DIABLO WATER DISTRICT

STANDARD DRAWING
BARNES LAYER RESISTIVITY

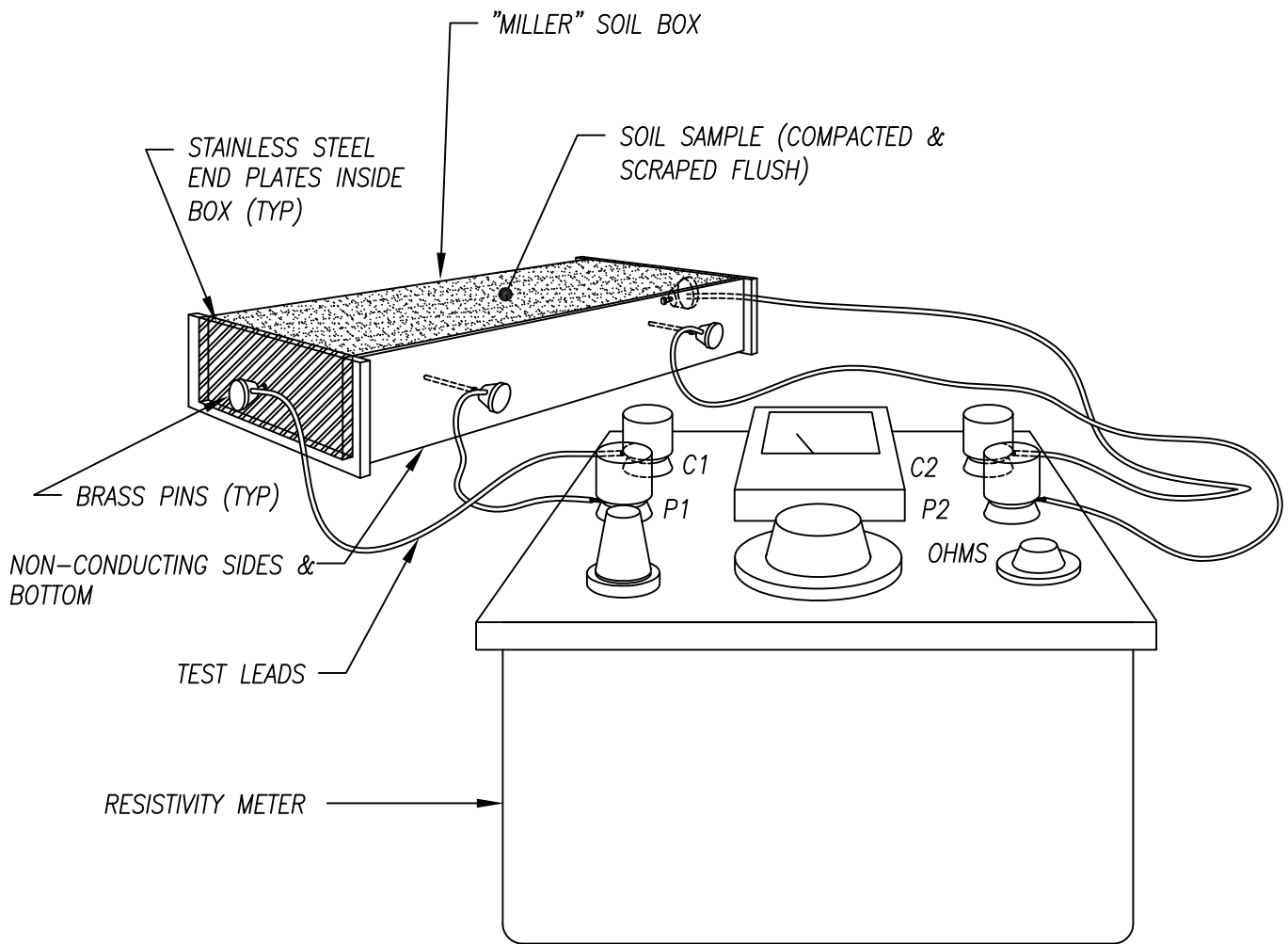
DESIGNED MA

DRAWN SC

APPROVED JDH

DATE DECEMBER 2013

DWG. NO. DWD C2



DIABLO WATER DISTRICT

STANDARD DRAWING
SOIL BOX RESISTIVITY TEST

DESIGNED

MA

DRAWN

SC

APPROVED

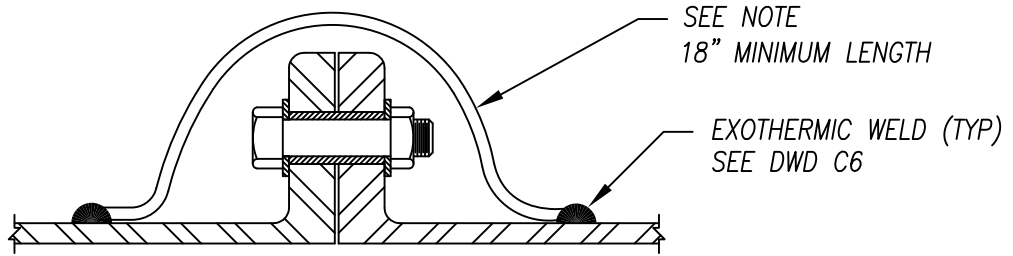
JDH

DATE

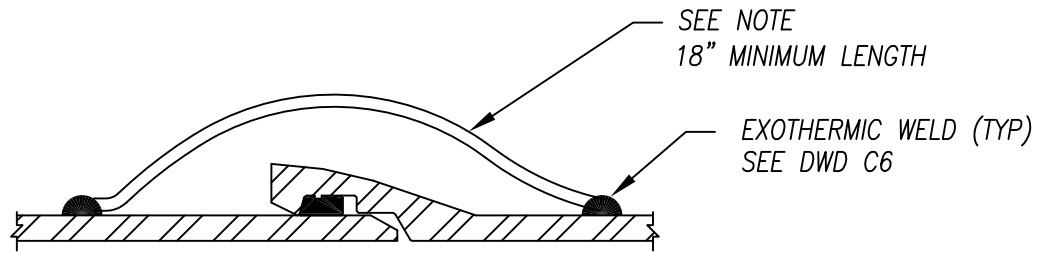
DECEMBER 2013

DWG. NO.

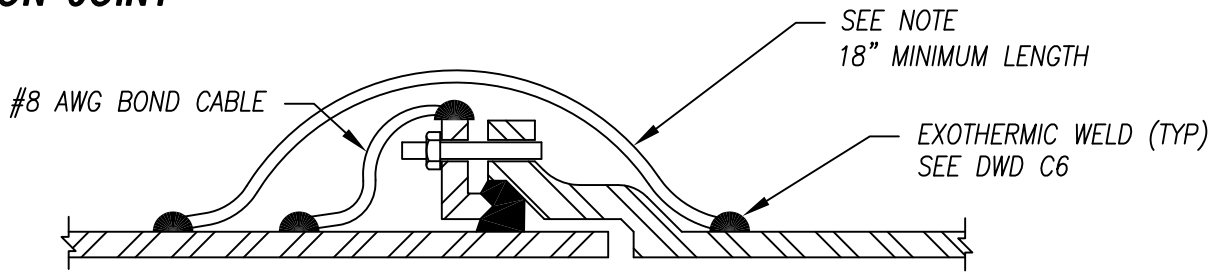
DWD C3



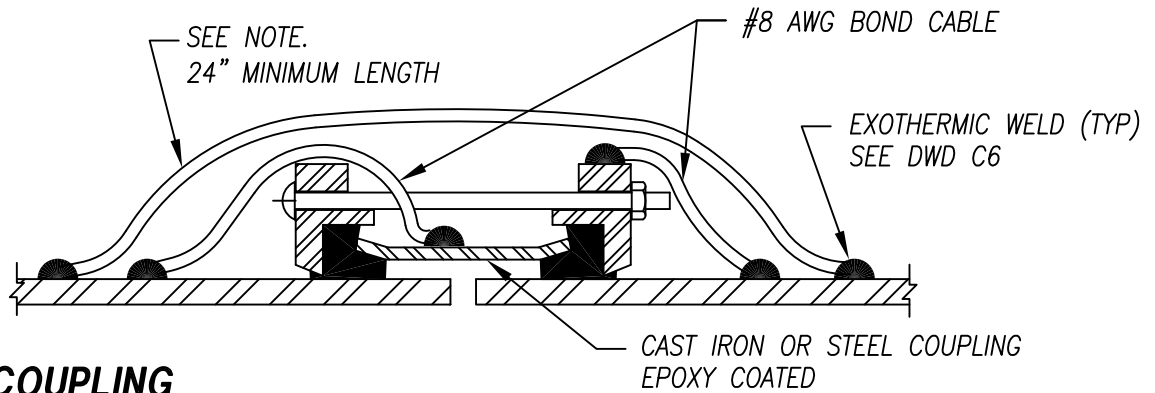
FLANGED JOINT



PUSH-ON JOINT



MECHANICAL JOINT



FLEXIBLE COUPLING

NOTE:

1. USE #8 AWG/HMWPE BOND CABLES FOR BONDING METALLIC FITTINGS ON NON-METALLIC PIPING SYSTEMS.
2. USE #4 AWG/HMWPE BOND CABLES FOR BONDING PIPE JOINTS ON METALLIC PIPING SYSTEMS PER SPECIFICATIONS.

DIABLO WATER DISTRICT

STANDARD DRAWING
BOND CABLES - METALLIC PIPE JOINTS
SACRIFICIAL ANODE SYSTEMS

DESIGNED

MA

DRAWN

SC

APPROVED

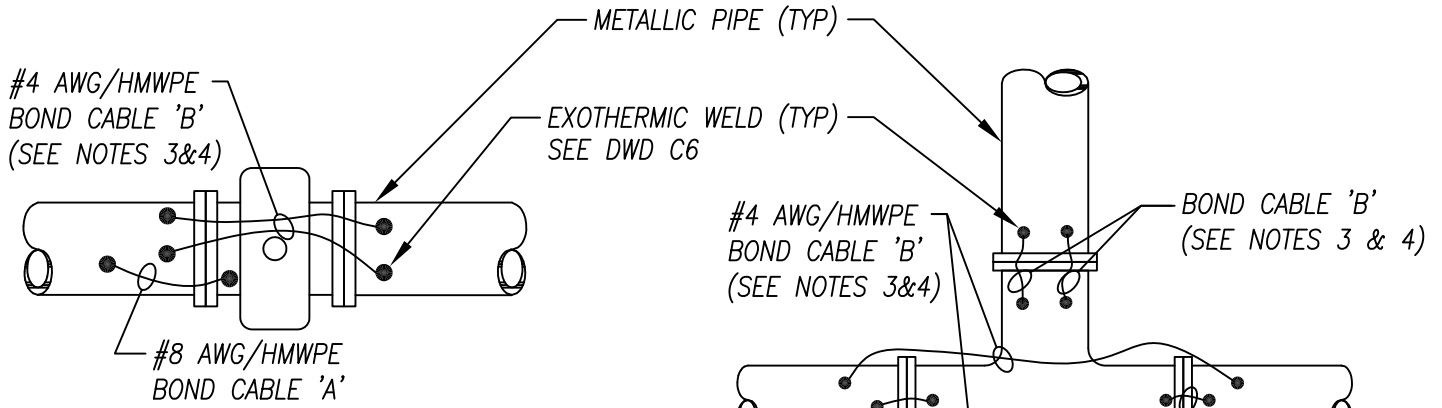
JDH

DATE

DECEMBER 2013

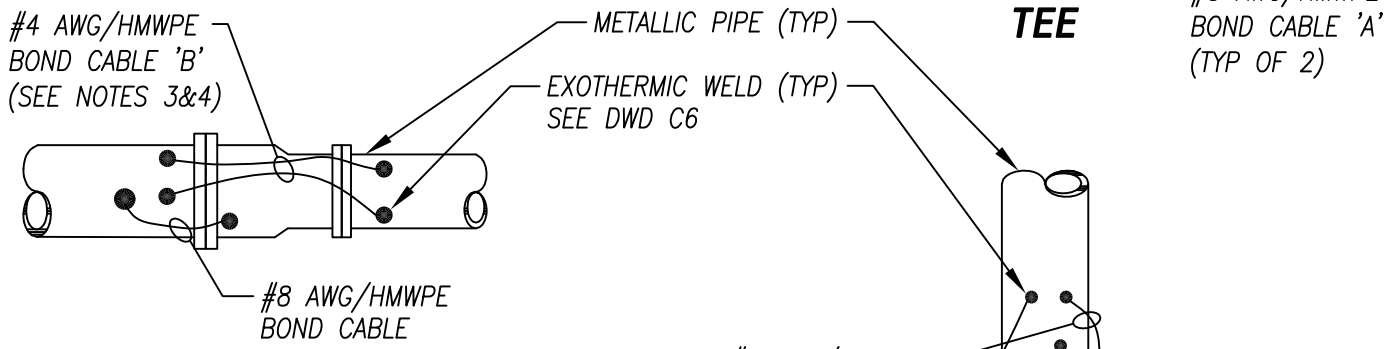
DWG. NO.

DWD C4



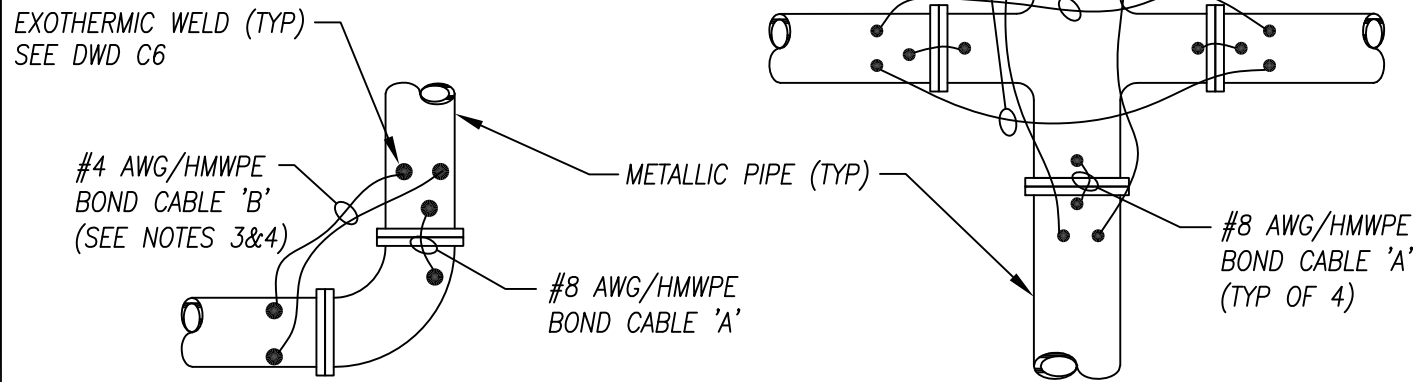
VALVE

TEE



ADAPTER

CROSS

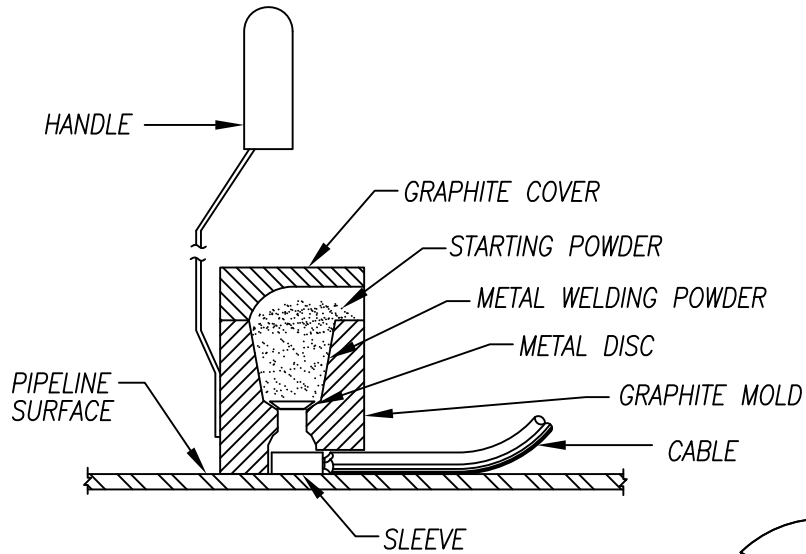


ELBOW

NOTE:

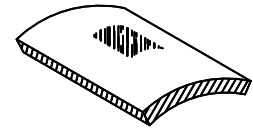
1. ALL BOND 'B' WIRES SHALL BE #4 AWG/HMWPE STRANDED COPPER WIRE.
2. ALL FITTING BOND WIRES 'A' SHALL BE #8 AWG/HMWPE STRANDED COPPER WIRE.
3. USE ONE (1) BOND CABLE 'B' ACROSS EACH FITTING FOR PIPE SIZES 18" IN DIAMETER OR SMALLER.
4. USE TWO (2) BOND CABLES 'B' ACROSS EACH FITTING FOR PIPE SIZES 20" IN DIAMETER OR LARGER.

| | | | | |
|-----------------------|-----------------|---|---------------------------|------------------------|
| DIABLO WATER DISTRICT | | STANDARD DRAWING BOND CABLES - ACROSS FITTINGS ON METALLIC PIPE | | |
| DESIGNED <u>MA</u> | DRAWN <u>SC</u> | APPROVED <u>JDH</u> | DATE <u>DECEMBER 2013</u> | DWG. NO. <u>DWD C5</u> |



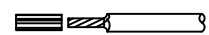
STEP 1.

FILE STRUCTURE CONNECTION AREA TO BARE SHINY METAL AND CLEAN.



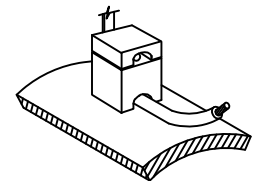
STEP 2.

STRIP INSULATION FROM WIRE. ATTACH SLEEVE REQUIRED ON #6 AWG WIRE OR SMALLER



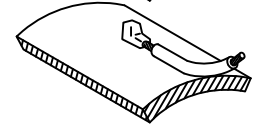
STEP 3.

HOLD MOLD FIRMLY WITH OPENING AWAY FROM OPERATOR AND IGNITE WITH FLINT GUN.



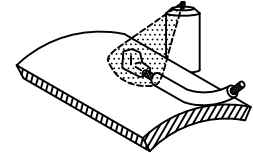
STEP 4.

REMOVE SLAG FROM CONNECTION AND PEEN WELD FOR SOUNDNESS.



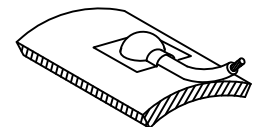
STEP 5.

SPRAY PRIMER ON BARE METAL.

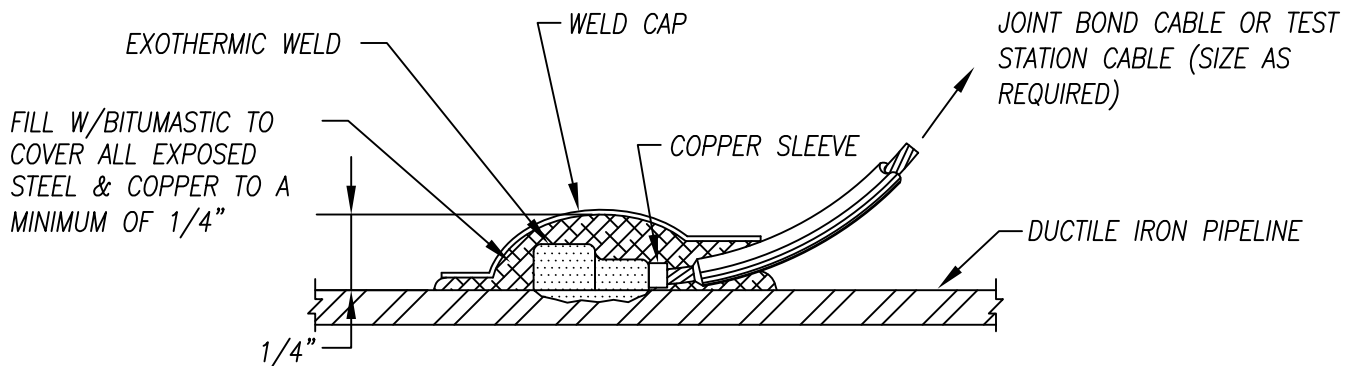


STEP 6.

COVER CONNECTION AND EXPOSED STRUCTURE SURFACE WITH PLASTIC CAP & BITUMASTIC



NOTE:
PROCEDURE SHOWN ABOVE IS TO BE USED AS A GENERAL GUIDE ONLY.
CONSULT MANUFACTURER'S LITERATURE FOR SPECIFIC INSTALLATION INSTRUCTIONS.



DIABLO WATER DISTRICT

STANDARD DRAWING
EXOTHERMIC WELD

DESIGNED

MA

DRAWN

SC

APPROVED

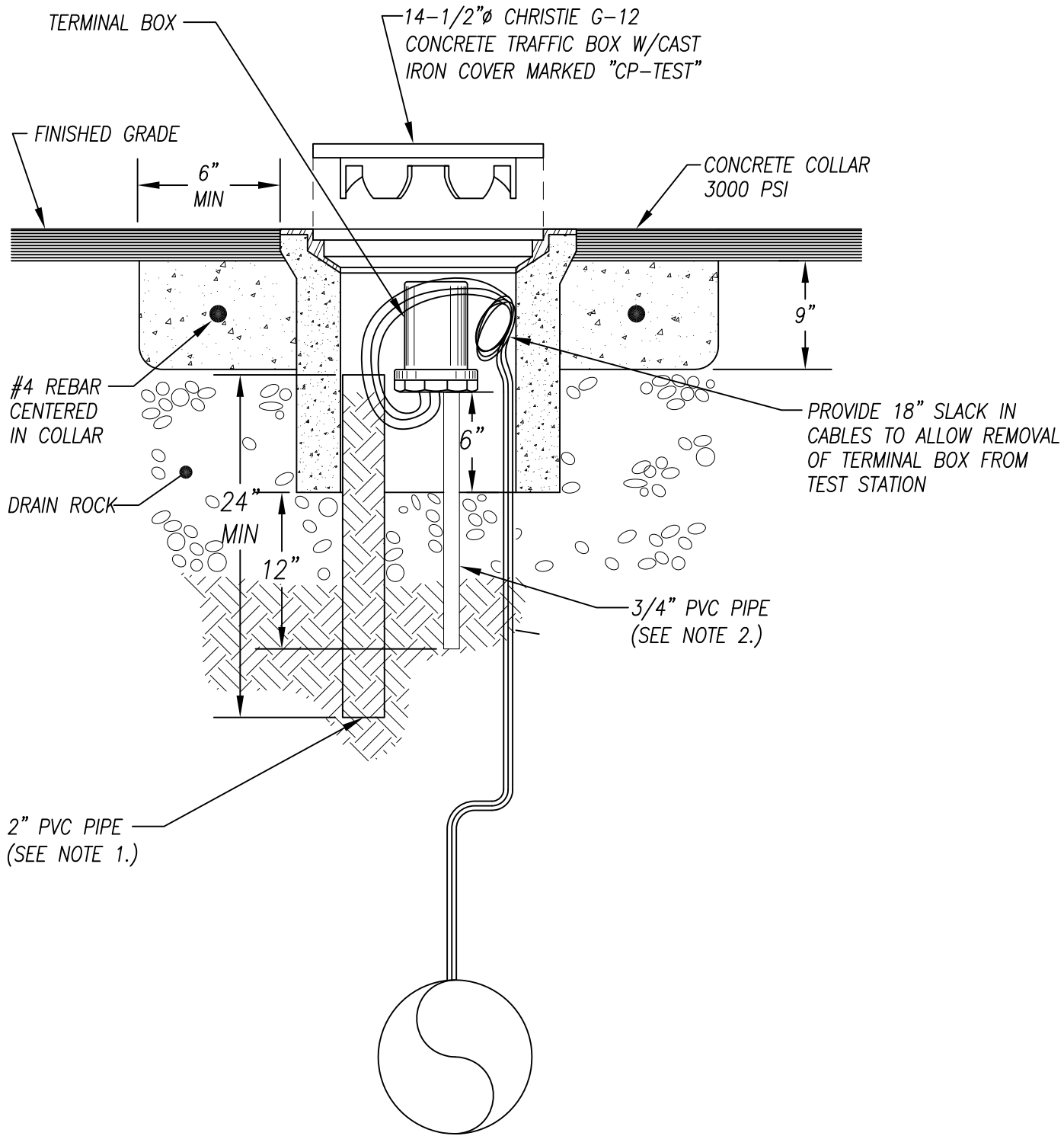
JDH

DATE

DECEMBER 2013

DWG. NO.

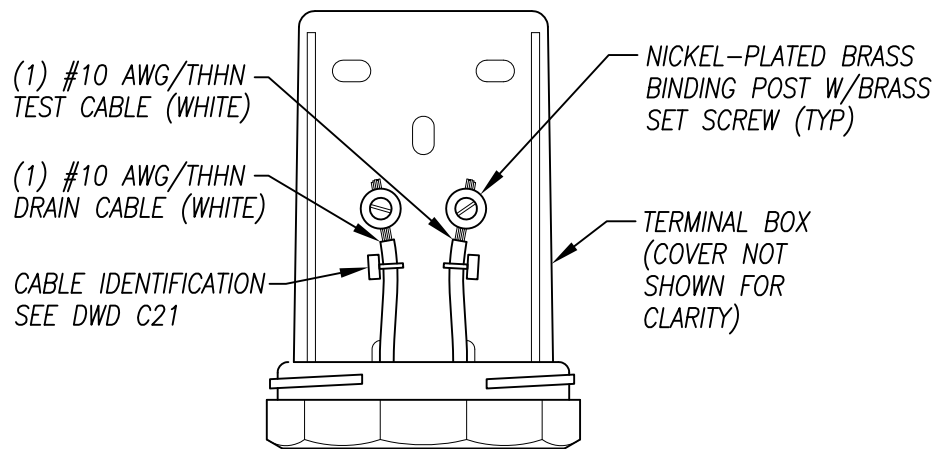
DWD C6



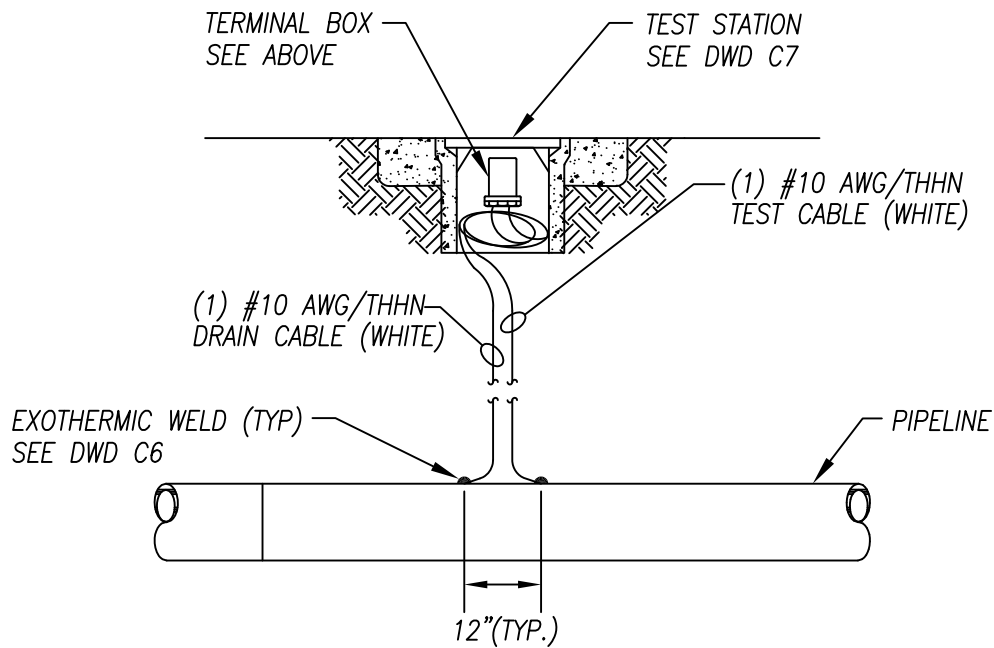
NOTES:

1. INSTALL 2" PVC PIPE IN CLEAN NATIVE SOIL. FILL PIPE WITH CLEAN SOIL, FREE FROM ROCKS & DEBRIS.
2. INSTALL 18" LENGTH OF 3/4" PVC PIPE TO ENSURE THAT THE TERMINAL BOX WILL REMAIN IN THE UPRIGHT POSITION. POSITION THE PIPE SO THAT THE TERMINAL BOX WILL BE AS HIGH AS POSSIBLE WITH THE CAST IRON LID STILL CLOSING PROPERLY.

| | | | | |
|-----------------------|----|--|----|---------------|
| DIABLO WATER DISTRICT | | STANDARD DRAWING FLUSH GRADE TEST STATION | | |
| DESIGNED | MA | DRAWN | SC | APPROVED |
| | | | | JDH |
| | | | | DATE |
| | | | | DECEMBER 2013 |
| | | | | DWG. NO. |
| | | | | DWD C7 |



CTS TERMINAL BOX



NOTE:
IDENTIFY CABLES PER DRAWING DWD C21.

DIABLO WATER DISTRICT

STANDARD DRAWING
CTS - CORROSION TEST STATION

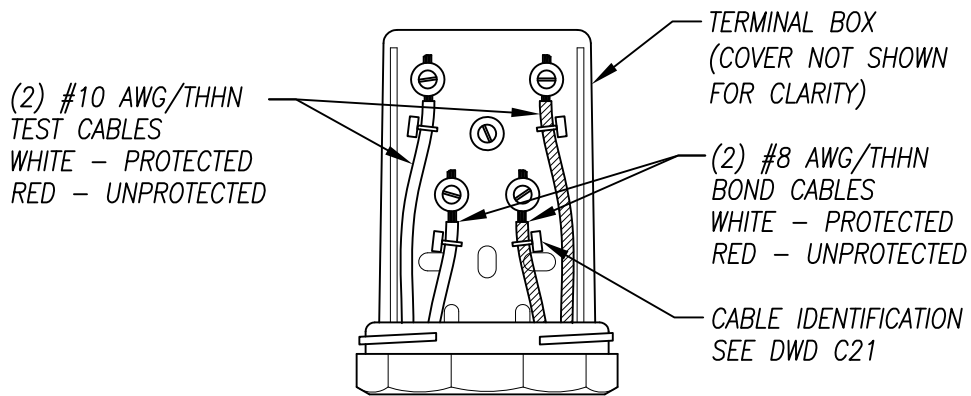
DESIGNED MA

DRAWN SC

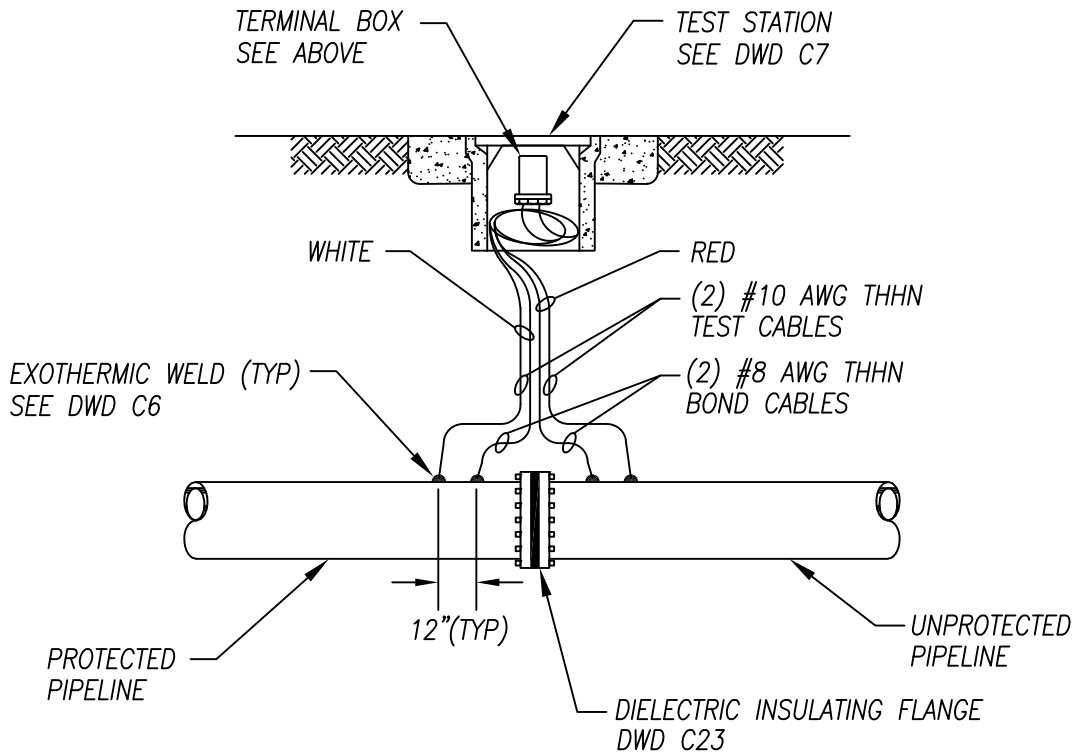
APPROVED JDH

DATE DECEMBER 2013

DWG. NO. DWD C8



IJTS TERMINAL BOX



NOTE:
 IDENTIFY CABLES PER DRAWING DWD C21.

DIABLO WATER DISTRICT

STANDARD DRAWING
 IJTS - INSULATING JOINT TEST STATION

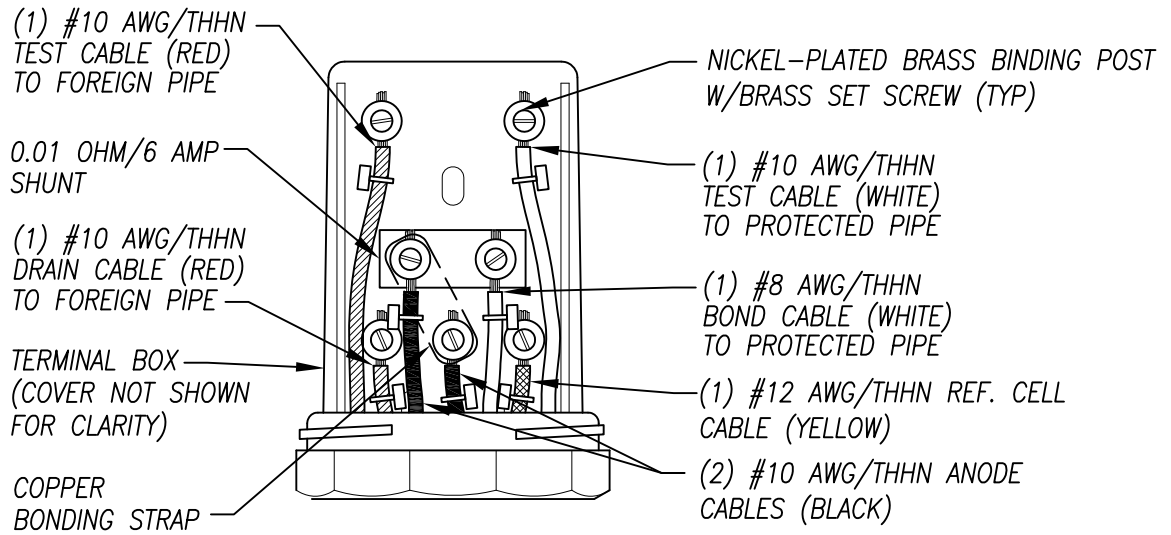
DESIGNED MA

DRAWN SC

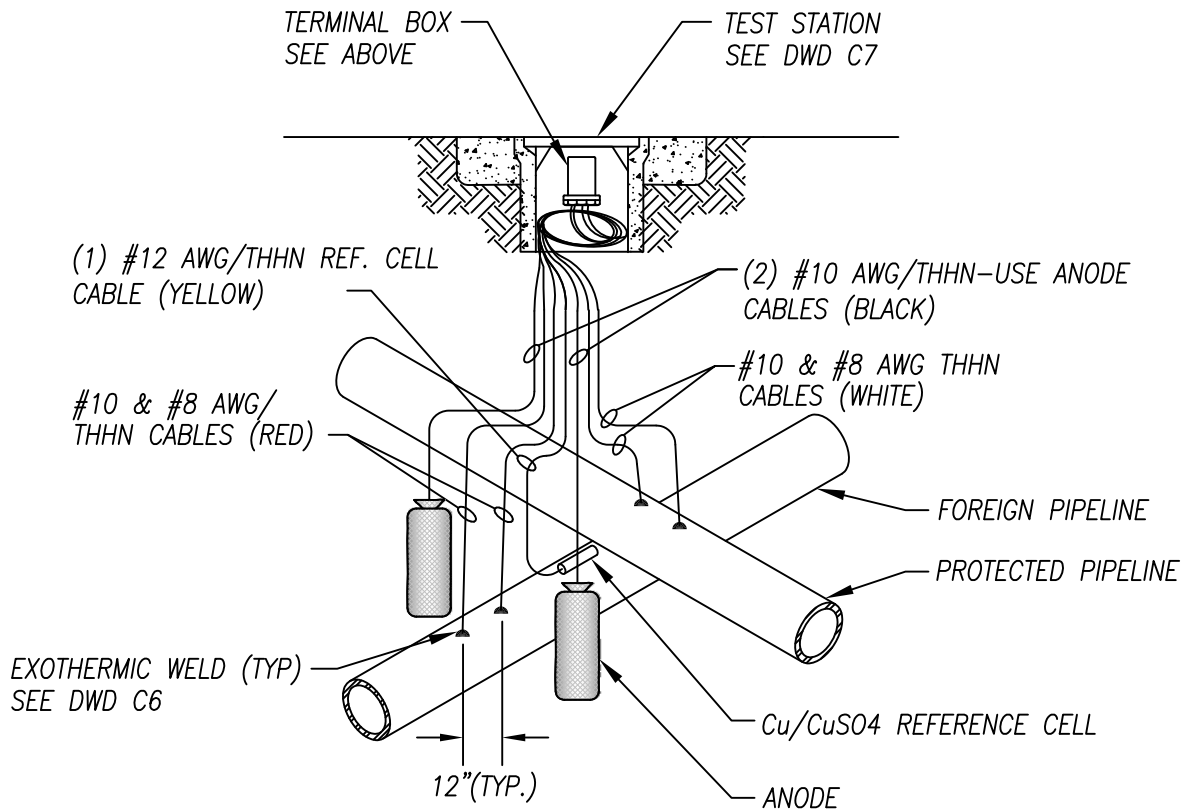
APPROVED JDH

DATE DECEMBER 2013

DWG. NO. DWD C9



FPTS TERMINAL BOX



NOTES:

1. IDENTIFY CABLES PER DRAWING DWD C21.
2. INSTALL THE REFERENCE CELL BETWEEN THE TWO PIPELINES.
3. PERMISSION MUST BE OBTAINED FROM THE FOREIGN PIPELINE OWNER PRIOR TO ATTACHMENT OF TEST WIRES.

DIABLO WATER DISTRICT

STANDARD DRAWING
FPTS - FOREIGN PIPELINE TEST STATION

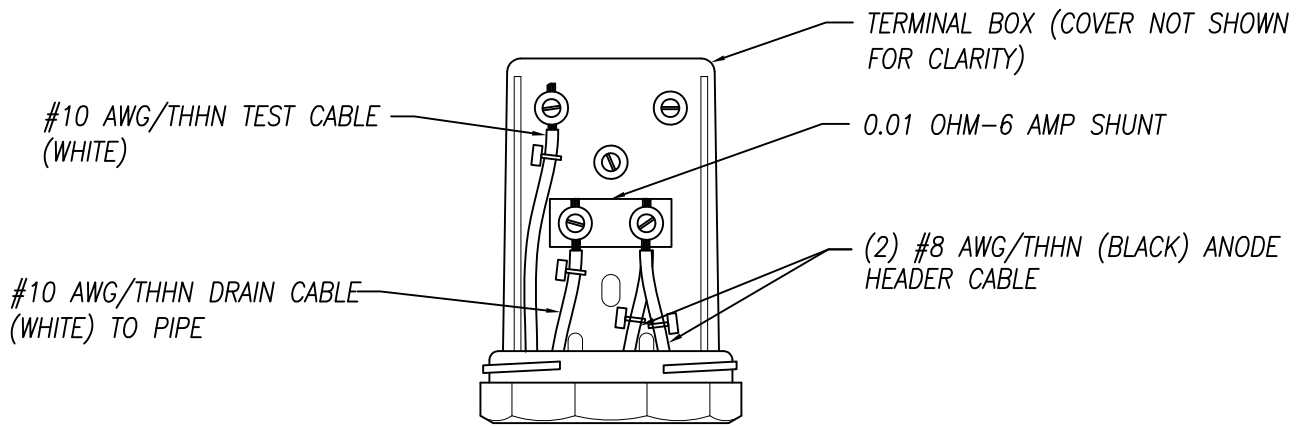
DESIGNED MA

DRAWN SC

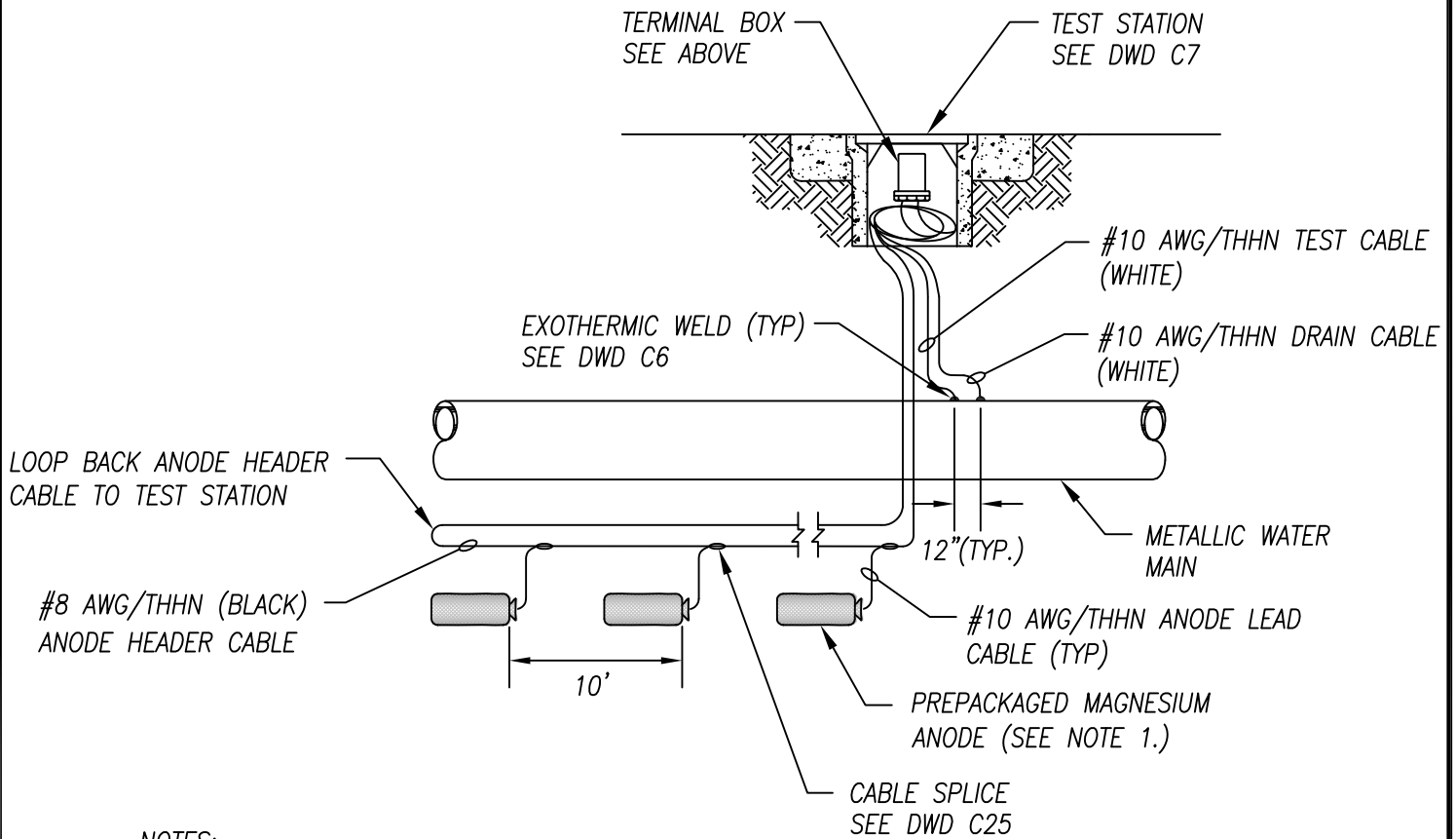
APPROVED JDH

DATE DECEMBER 2013

DWG. NO. DWD C10



ATS TERMINAL BOX



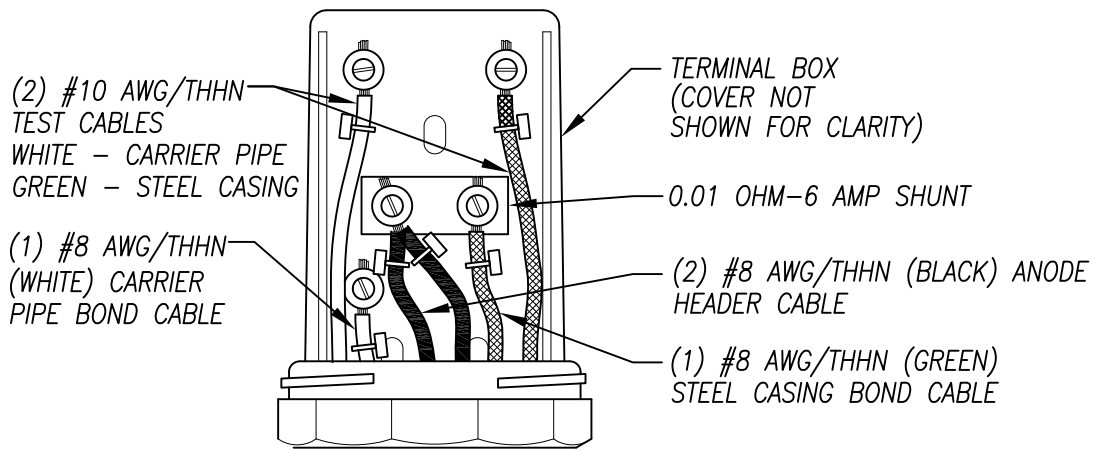
NOTES:

1. NUMBER AND SIZE OF ANODES SHALL BE DETERMINED BY THE PROJECT CORROSION ENGINEER.
2. THE ANODES SHALL BE INSTALLED A MINIMUM OF 3 FT. OFF THE WALL OF THE WATER PIPE.
3. BOND ALL PIPE JOINTS PER DRAWING DWD C6.
4. IDENTIFY CABLES PER DRAWING DWD C21.

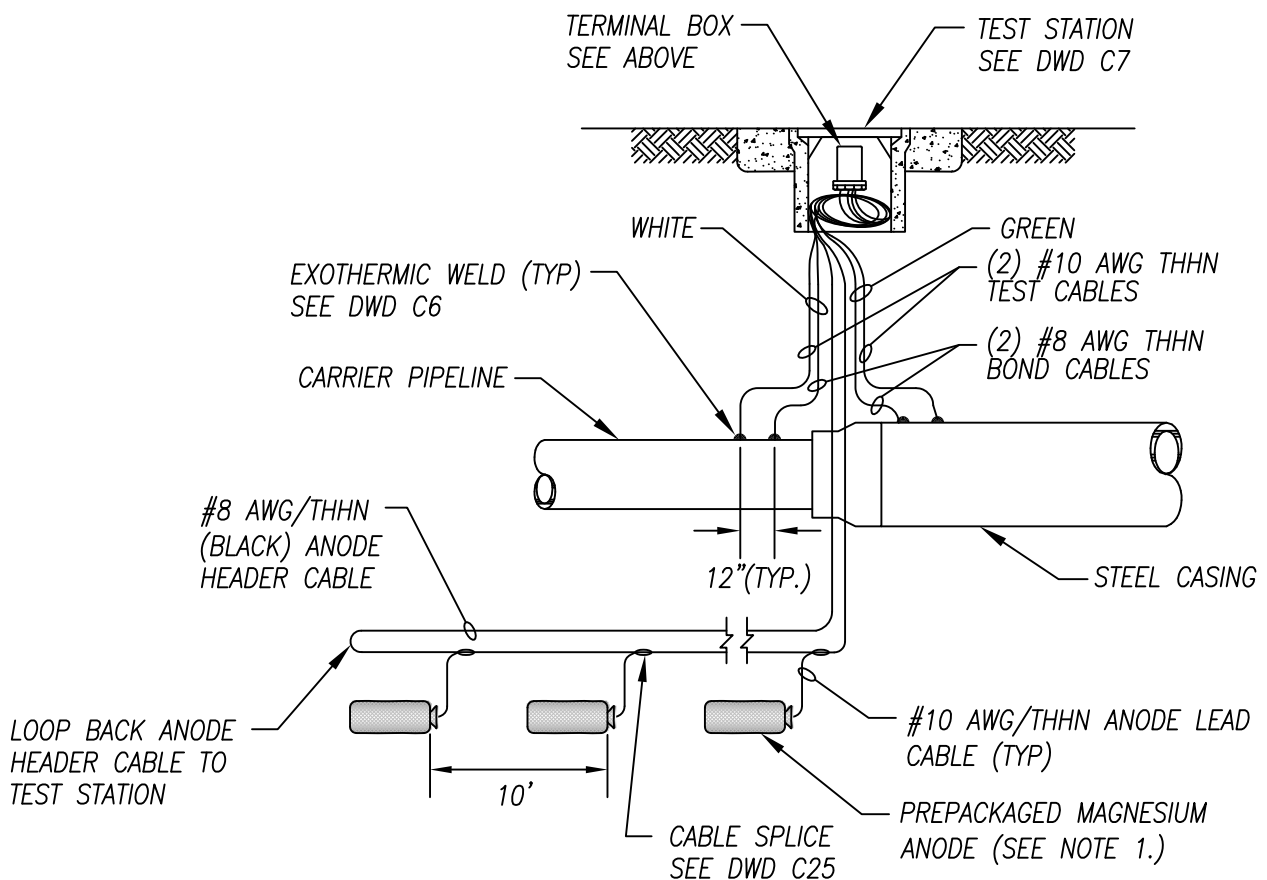
DIABLO WATER DISTRICT

STANDARD DRAWING
ATS - ANODE TEST STATION

| | | | | |
|--------------------|-----------------|---------------------|---------------------------|-------------------------|
| DESIGNED <u>MA</u> | DRAWN <u>SC</u> | APPROVED <u>JDH</u> | DATE <u>DECEMBER 2013</u> | DWG. NO. <u>DWD C11</u> |
|--------------------|-----------------|---------------------|---------------------------|-------------------------|



CATS TERMINAL BOX

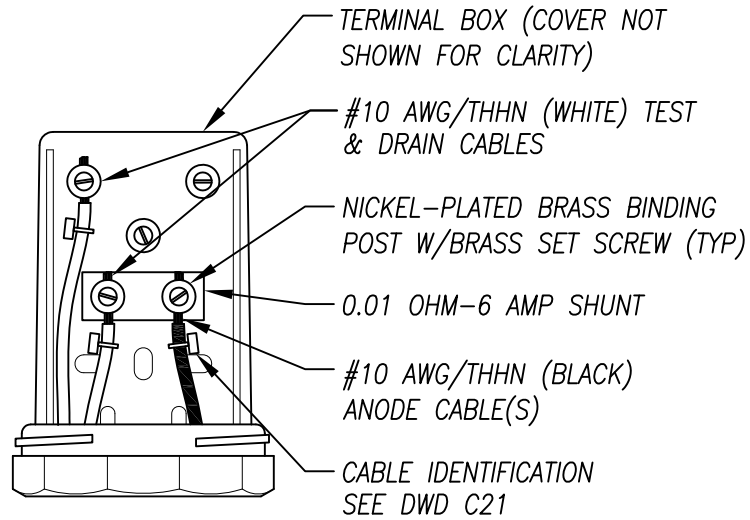


NOTE:

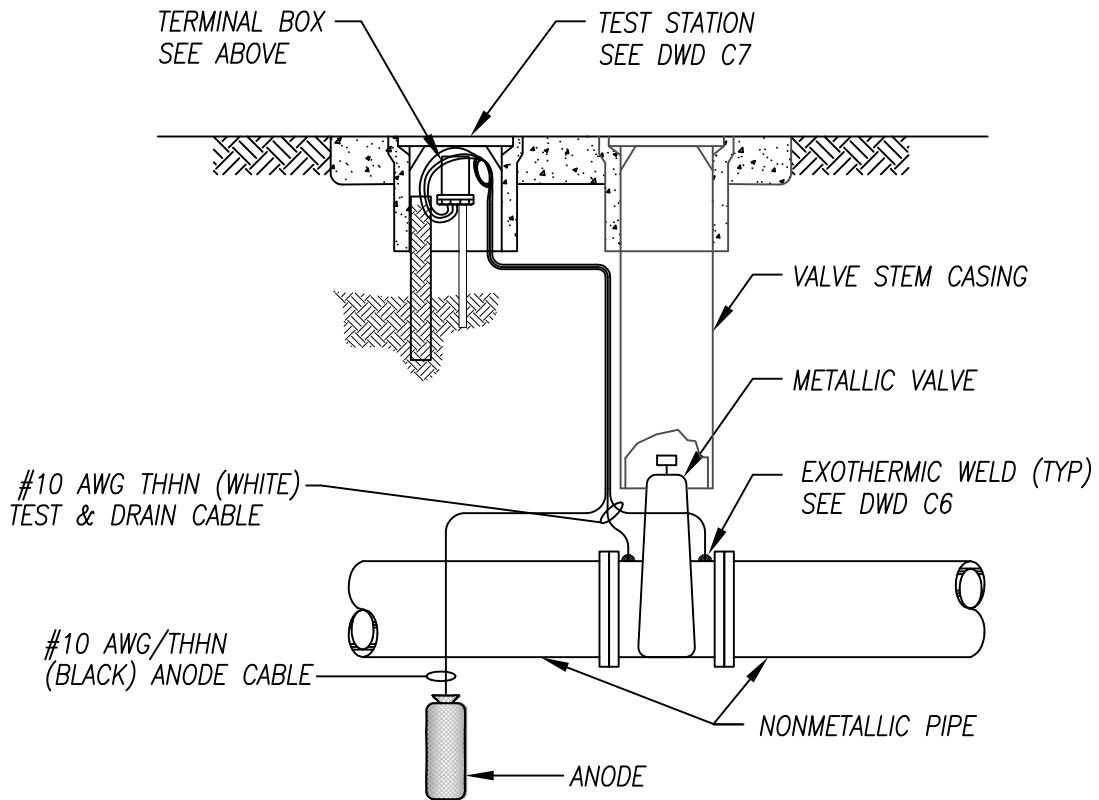
1. NUMBER AND SIZE OF ANODES SHALL BE DETERMINED BY THE PROJECT CORROSION ENGINEER.
2. CARRIER PIPE & CASING ARE TO BE ELECTRICALLY ISOLATED VIA CASING INSULATORS.
3. IF CARRIER PIPE IS NON-METALLIC DELETE WHITE CABLES AND EXOTHERMIC WELDS.
3. BOND ALL PIPE JOINTS PER DRAWING DWD C6.
4. IDENTIFY CABLES PER DRAWING DWD C21.

DIABLO WATER DISTRICT

STANDARD DRAWING
CATS - CASING TEST STATION



ATS TERMINAL BOX



NOTE:

1. INSTALL ANODE A MINIMUM OF 3- FEET FROM VALVE.
2. IDENTIFY CABLES PER DRAWING DWD C21.

DIABLO WATER DISTRICT

STANDARD DRAWING
VATS - VALVE ANODE TEST STATION

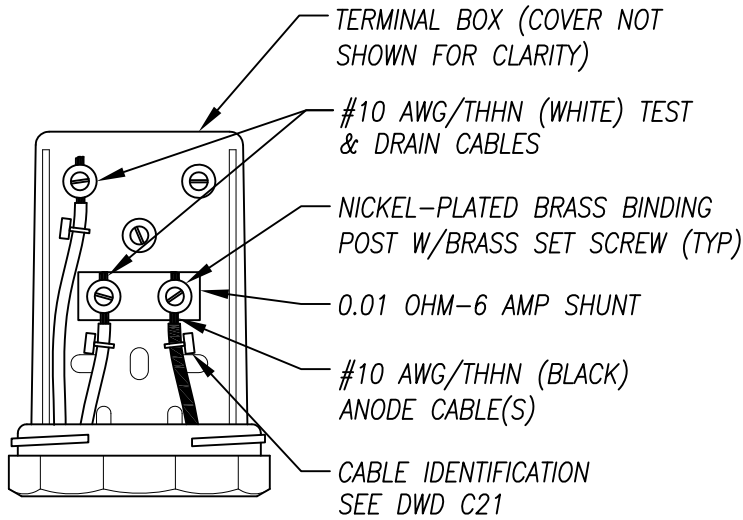
DESIGNED MA

DRAWN SC

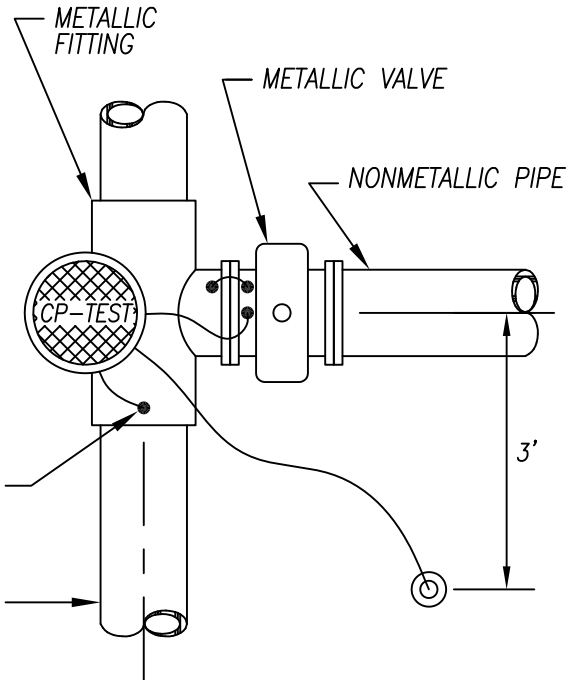
APPROVED JDH

DATE DECEMBER 2013

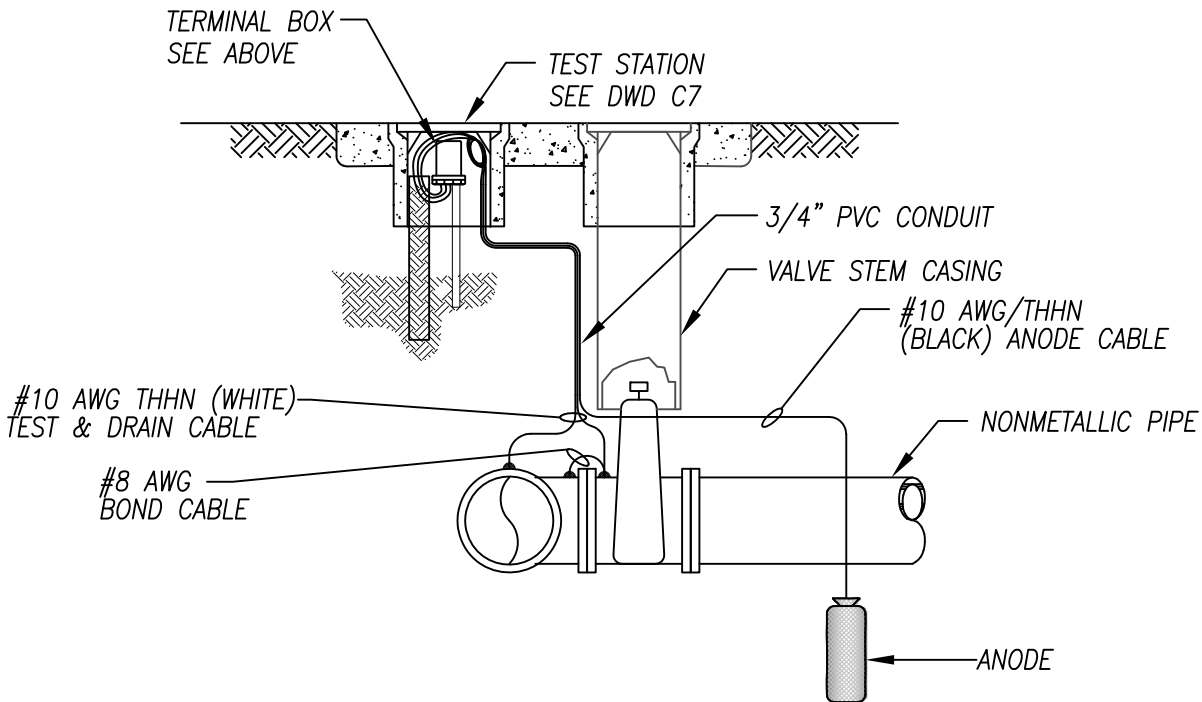
DWG. NO. DWD C13



ATS TERMINAL BOX



PLAN



PROFILE

NOTES:

1. INSTALL ANODE A MINIMUM OF 3- FEET FROM THE VALVE & TEE.
2. IDENTIFY ALL CABLES PER DRAWING DWD C21.

DIABLO WATER DISTRICT

STANDARD DRAWING
VALVE AND TEE ANODE TEST STATION

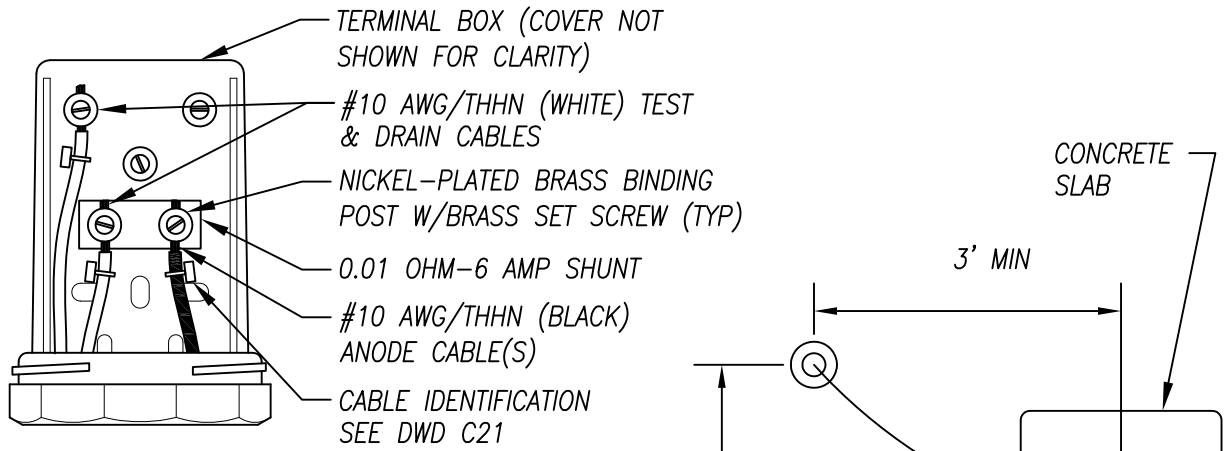
DESIGNED MA

DRAWN SC

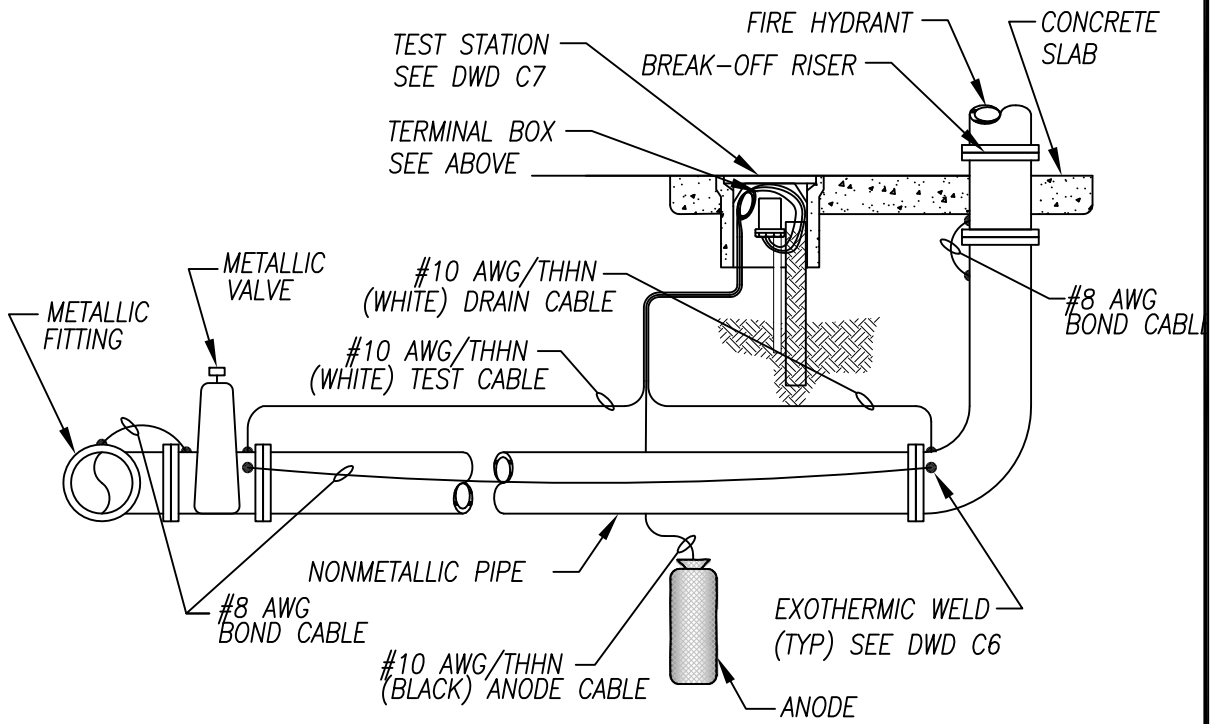
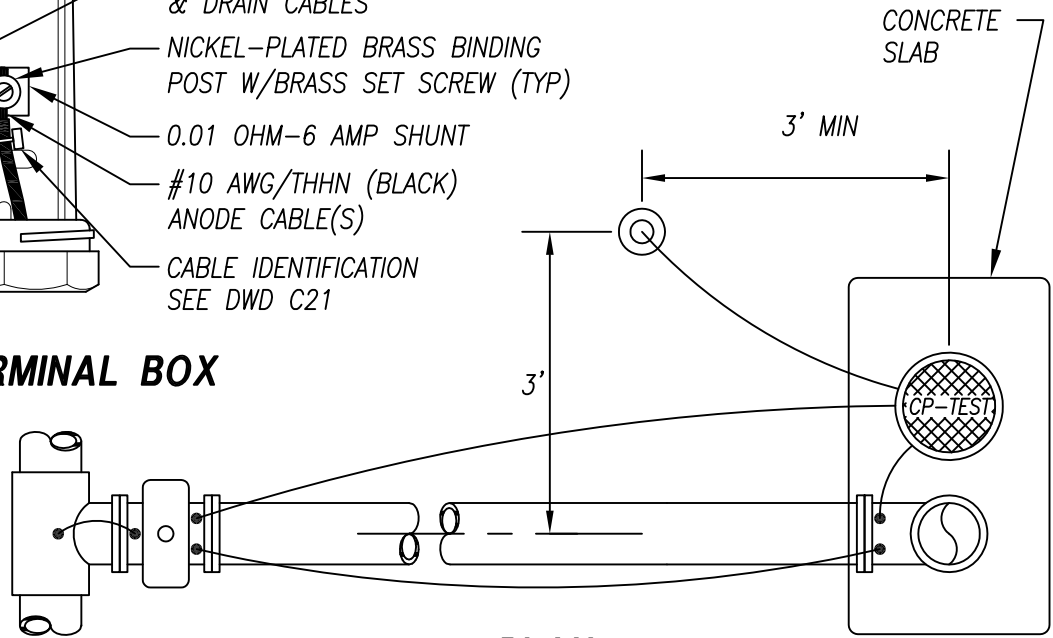
APPROVED JDH

DATE DECEMBER 2013

DWG. NO. DWD C14



ATS TERMINAL BOX



NOTES:

1. IDENTIFY ALL CABLES PER DRAWING DWD C21.
2. INSTALL TEST STATION IN COMMON CONCRETE SLAB WITH F.H. RISER.

DIABLO WATER DISTRICT

STANDARD DRAWING
FIRE HYDRANT

DESIGNED

MA

DRAWN

SC

APPROVED

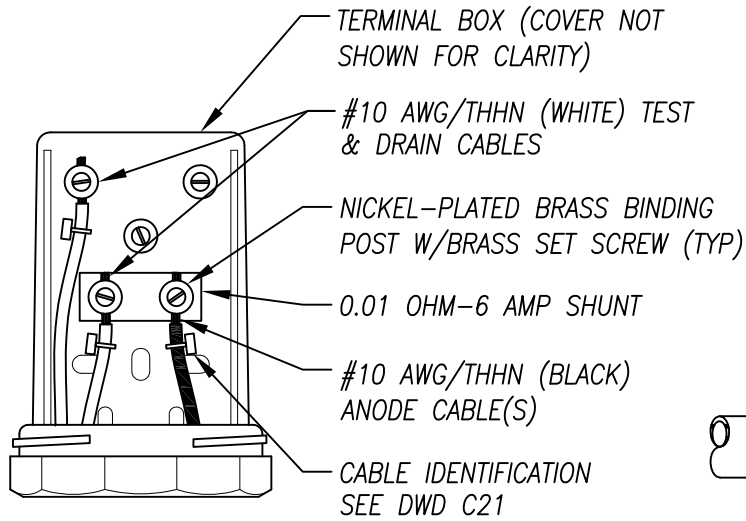
JDH

DATE

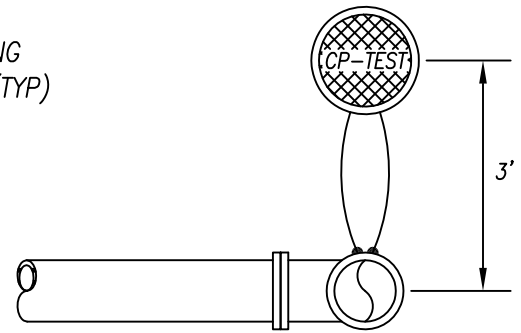
DECEMBER 2013

DWG. NO.

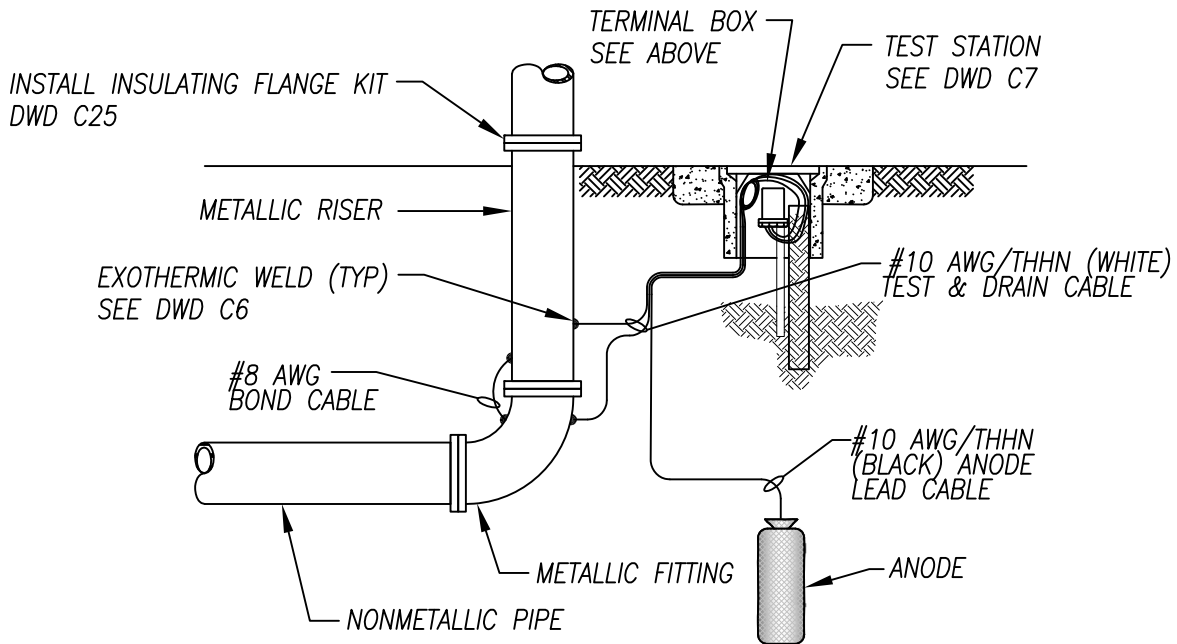
DWD C15



ATS TERMINAL BOX



PLAN



PROFILE

NOTE:
1. IDENTIFY ALL CABLES PER DRAWING DWD C21.

DIABLO WATER DISTRICT

STANDARD DRAWING
METALLIC RISER

DESIGNED

MA

DRAWN

SC

APPROVED

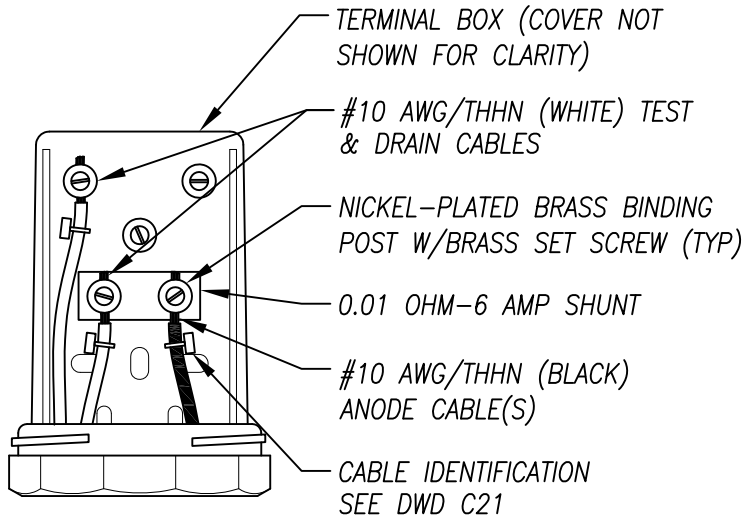
JDH

DATE

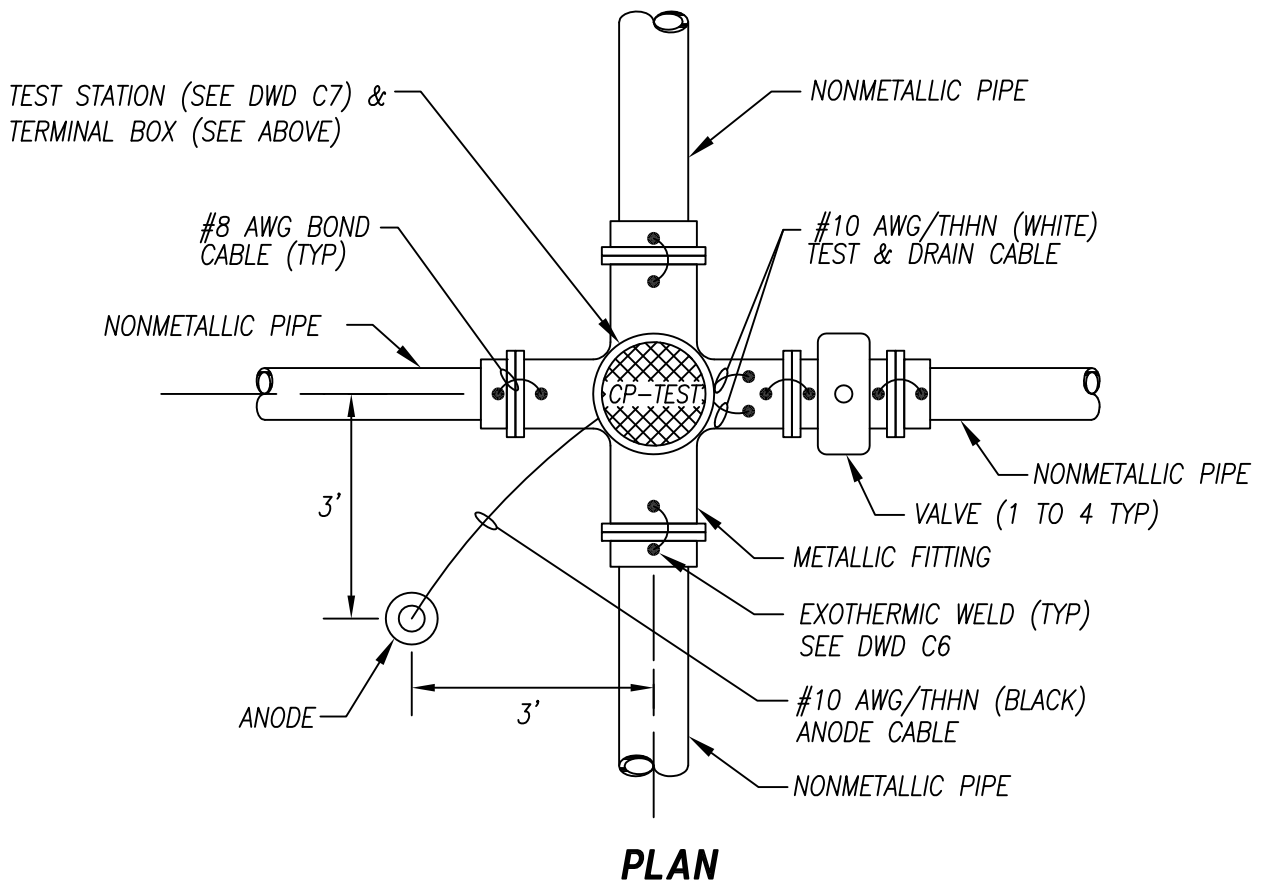
DECEMBER 2013

DWG. NO.

DWD C16



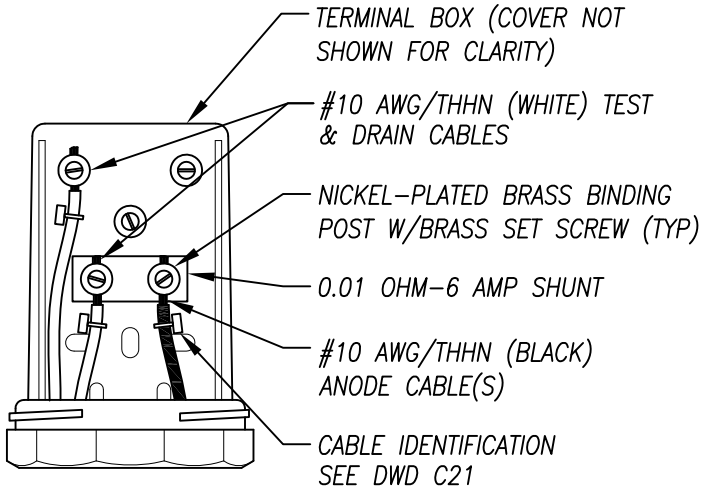
ATS TERMINAL BOX



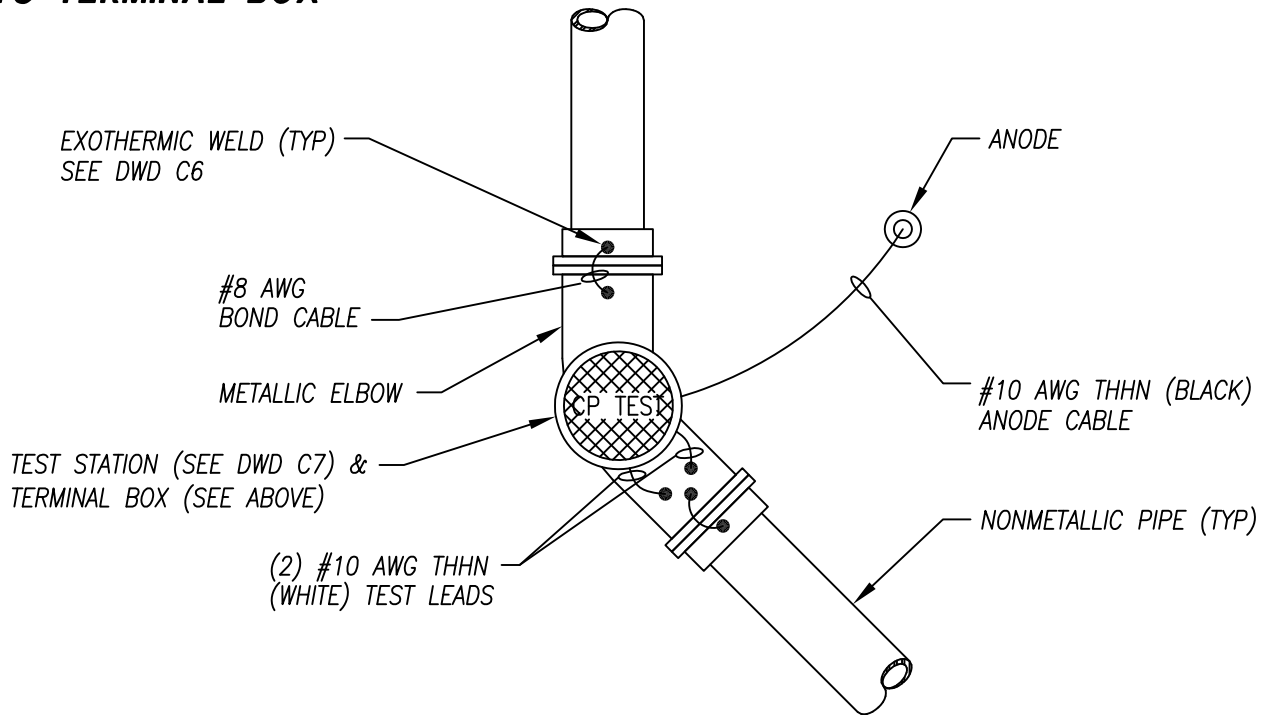
NOTE:
1. IDENTIFY ALL CABLES PER DRAWING DWD C21.

DIABLO WATER DISTRICT

STANDARD DRAWING
CROSS AND VALVES



ATS TERMINAL BOX



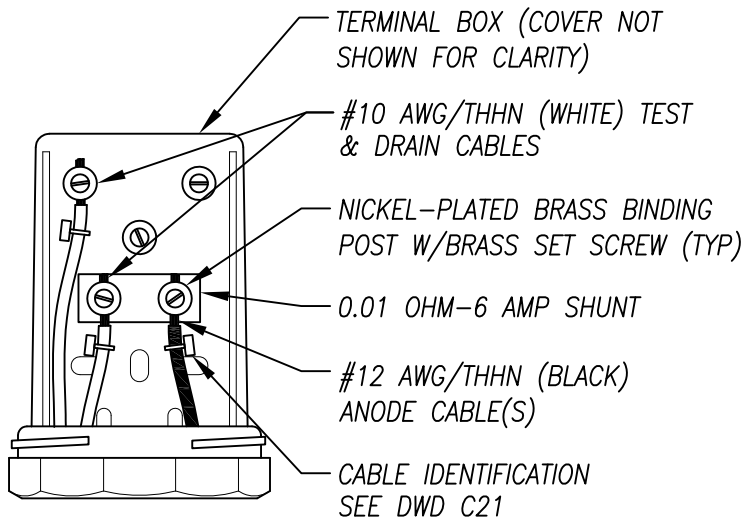
PLAN

NOTE:

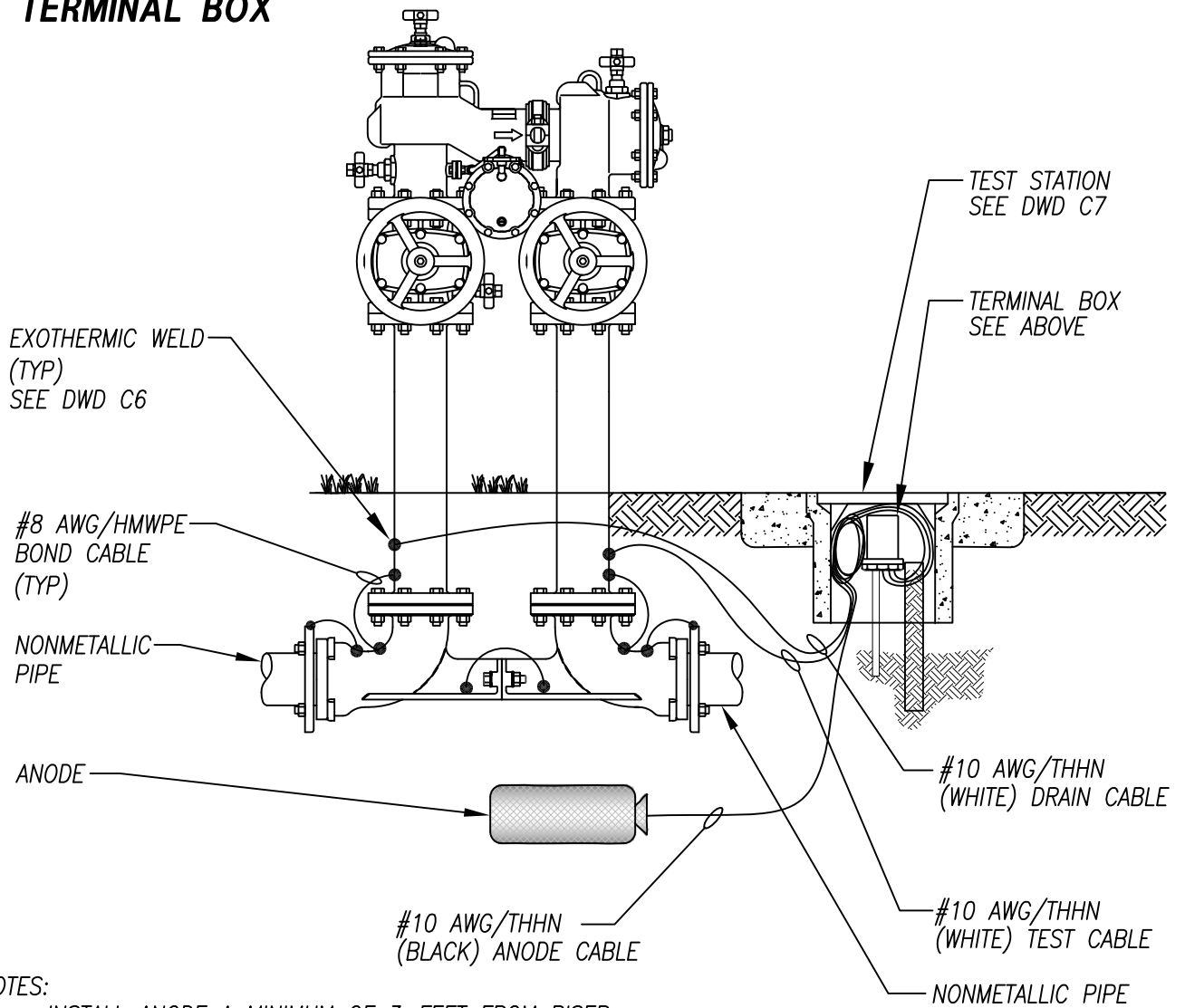
1. IDENTIFY ALL CABLES PER DRAWING DWD C21.

DIABLO WATER DISTRICT

STANDARD DRAWING
ELBOW



ATS TERMINAL BOX



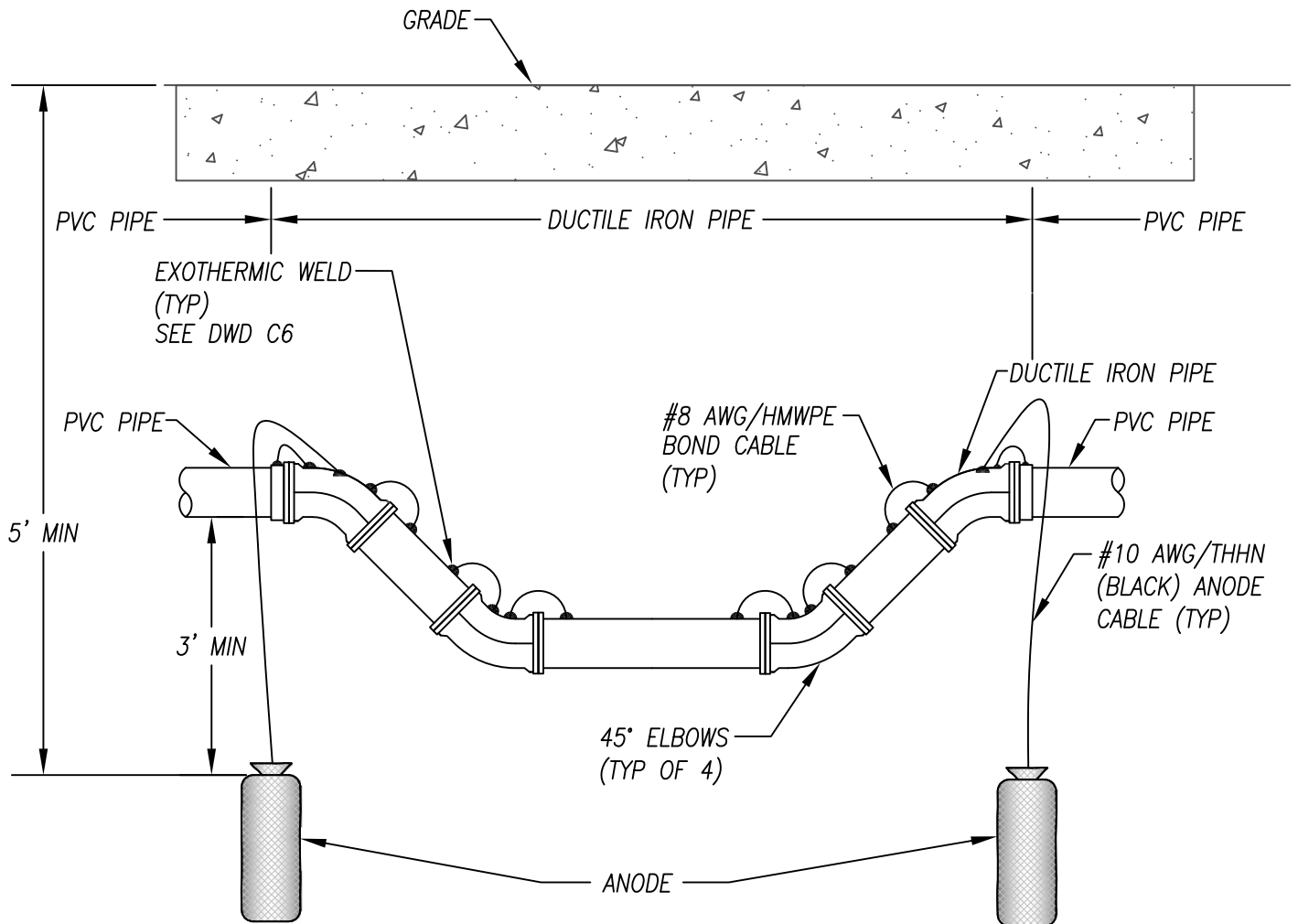
NOTES:

1. INSTALL ANODE A MINIMUM OF 3- FEET FROM RISER.
2. IDENTIFY ALL CABLES PER DRAWING DWD C19.

DIABLO WATER DISTRICT

STANDARD DRAWING
 DOUBLE DETECTOR CHECK ASSEMBLY PREVENTER
 OR REDUCED PRESSURE BACKFLOW PREVENTER

| | | | |
|--------------------|-----------------|---------------------|---------------------------|
| DESIGNED <u>MA</u> | DRAWN <u>SC</u> | APPROVED <u>JDH</u> | DATE <u>DECEMBER 2013</u> |
| | | | DWG. NO. <u>DWD C19</u> |



NOTE:

1. THIS DETAIL MAY BE USED FOR ALL UNDERGROUND SECTIONS OF DUCTILE IRON PIPE INCLUDING CROSSING UNDER OR OVER A PIPE, BRIDGE AND SHORT RUNS OF DUCTILE IRON PIPE. IN ALL CASES A MINIMUM OF ONE ANODE SHALL BE INSTALLED ON EACH END OF A DUCTILE IRON PIPE SEGMENT.
2. THE ANODE SHALL BE INSTALLED VERTICALLY OR HORIZONTALLY WITH THE TOP OF THE ANODE 5 FT. BELOW GRADE AND 3 FT. BELOW PIPE.
3. THE BOND CABLES MAY NOT BE REQUIRED IF IT IS DETERMINED DURING TESTING THAT THE DUCTILE IRON PIPE SEGMENT IS ELECTRICALLY CONTINUOUS FROM END TO END.

DIABLO WATER DISTRICT

STANDARD DRAWING
DOUBLE OFFSET

DESIGNED

MA

DRAWN

SC

APPROVED

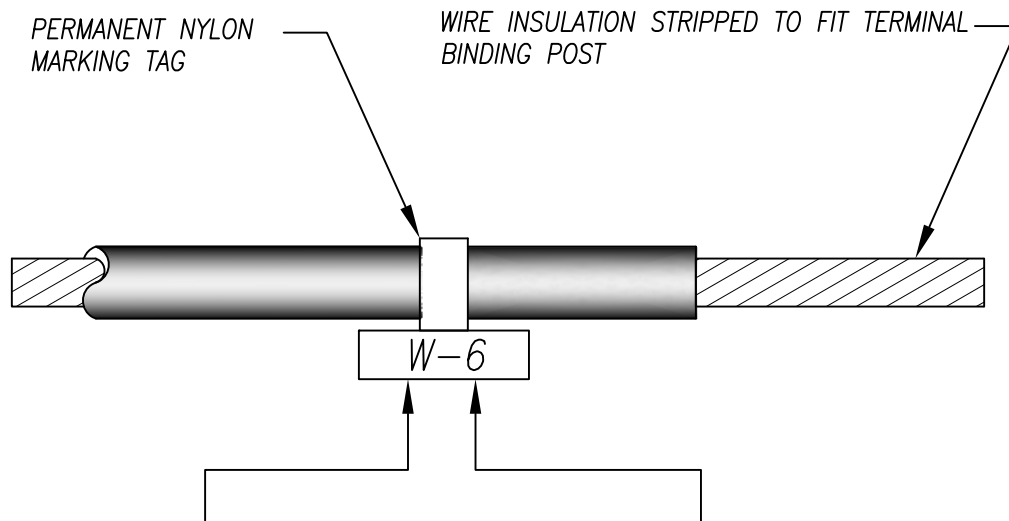
JDH

DATE

DECEMBER 2013

DWG. NO.

DWD C20



ABBREVIATIONS

- AN - ANODE*
- BO - BLOW OFF*
- CA - CASING*
- DR - DRAIN CABLE*
- DW - DOMESTIC WATER*
- EL - ELBOW*
- FH - FIRE HYDRANT*
- FP - FOREIGN PIPELINE*
- RE - REFERENCE ELECTRODE*
- RW - RAW WATER*

NUMBER

PIPE DIA. (INCHES)

DIABLO WATER DISTRICT

STANDARD DRAWING
CABLE IDENTIFICATION

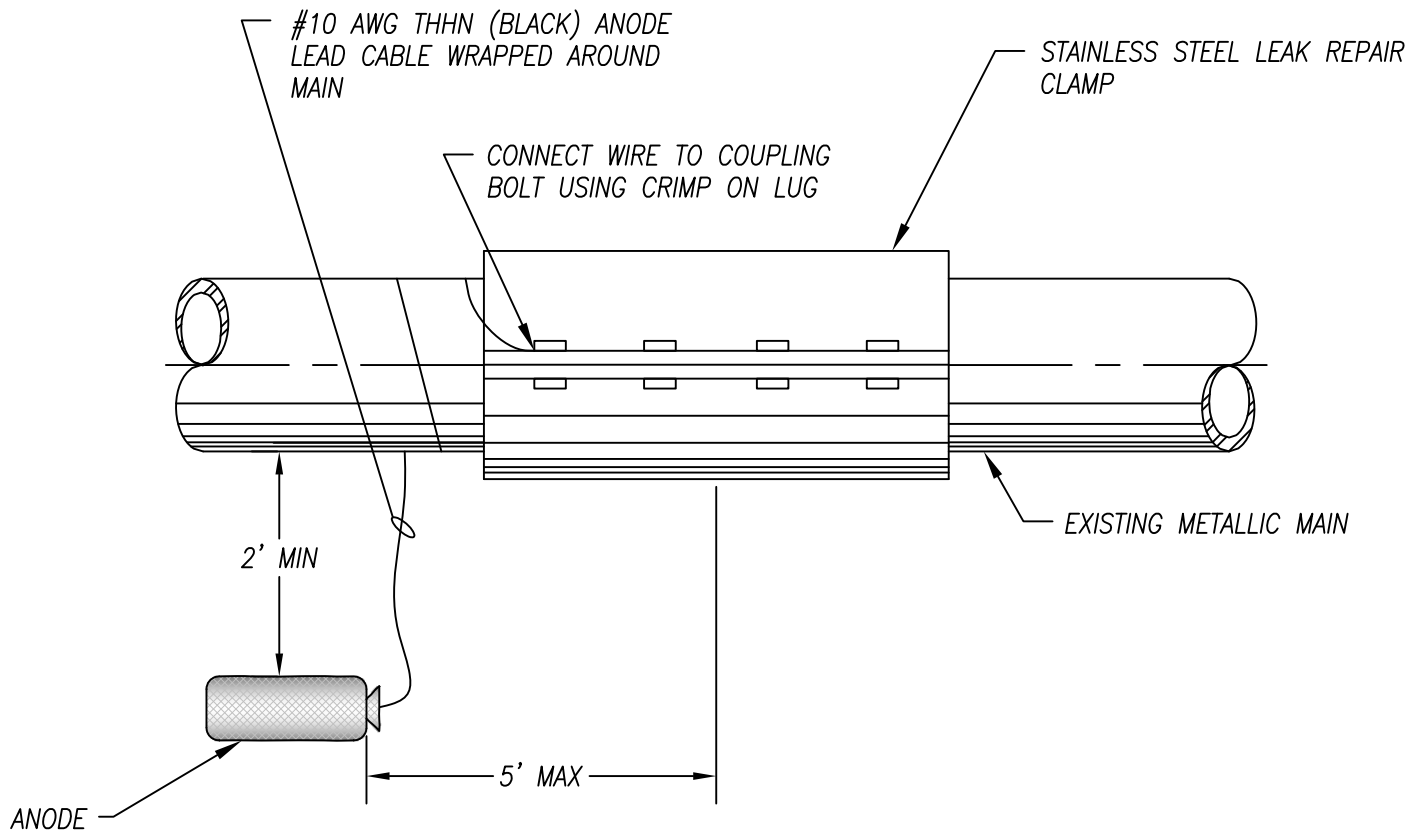
DESIGNED MA

DRAWN SC

APPROVED JDH

DATE DECEMBER 2013

DWG. NO. DWD C21



NOTES:

1. INSTALL ANODE A MINIMUM OF 2- FEET BELOW PIPE DEPTH IN NATIVE SOIL.
2. MAXIMUM HORIZONTAL DISTANCE FROM ANODE TO LEAK REPAIR CLAMP IS 5- FEET.

DIABLO WATER DISTRICT

STANDARD DRAWING
ANODE AT LEAK REPAIR CLAMP

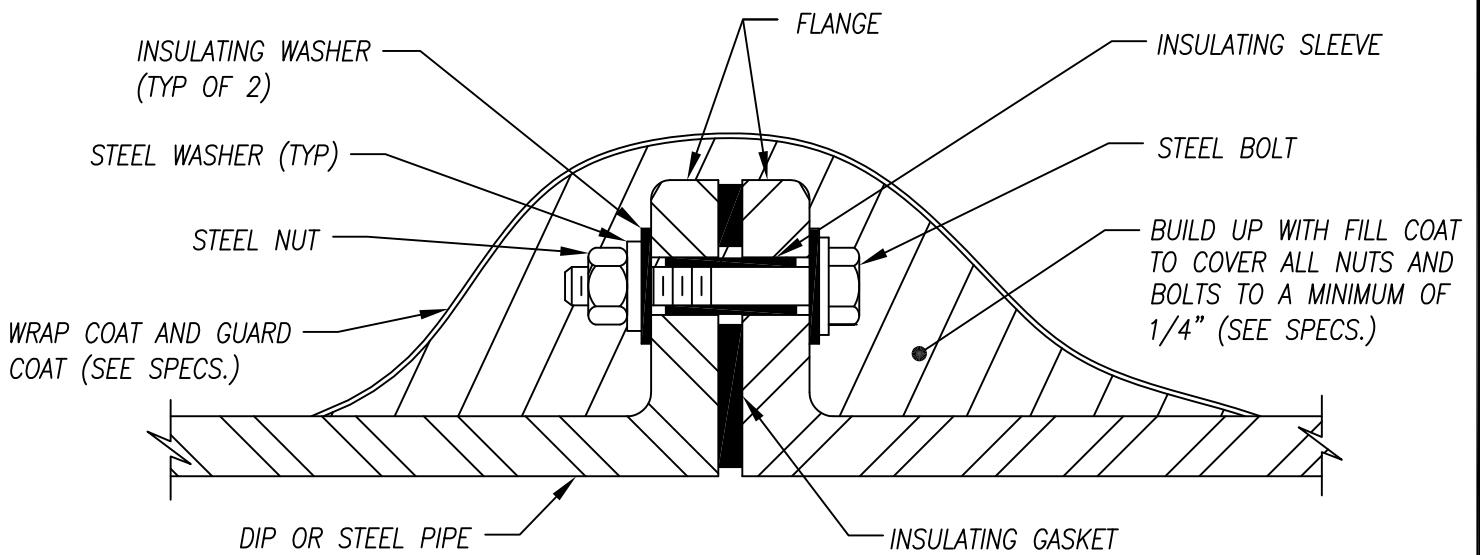
DESIGNED MA

DRAWN SC

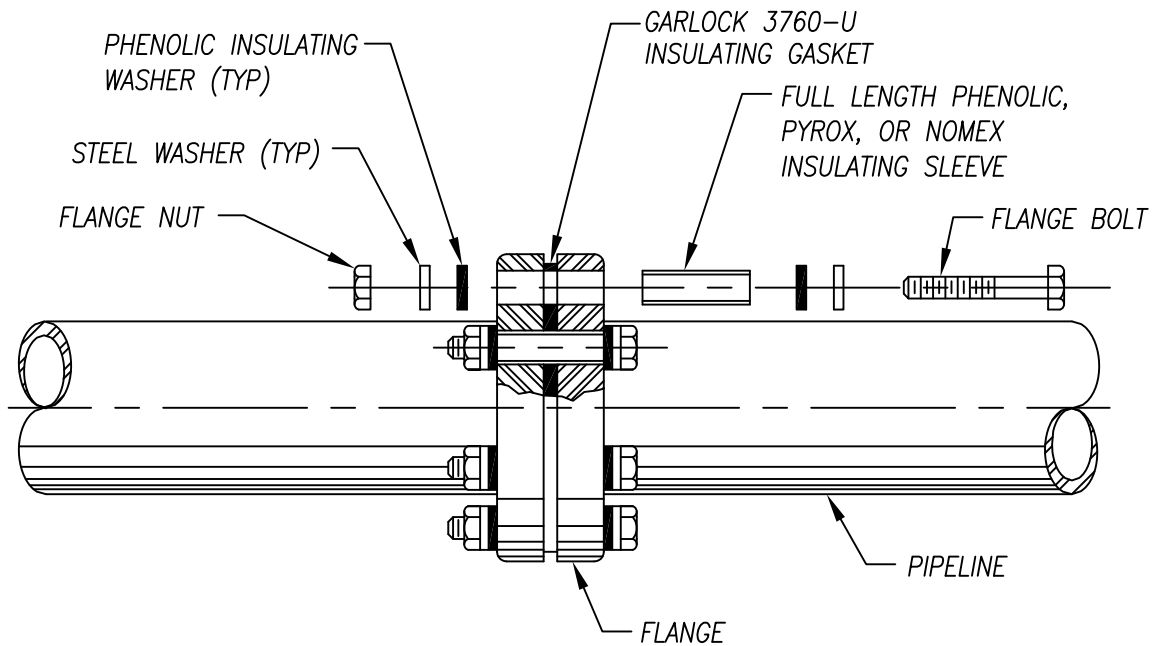
APPROVED JDH

DATE DECEMBER 2013

DWG. NO. DWD C22



BELOW GRADE INSULATING JOINT COATING



ABOVE GRADE INSULATING JOINT COATING

NOTE:

1. GASKET SHALL BE FOR WATER SERVICE AND BE OF THE SAME PRESSURE RATING AS THE FLANGE.

DIABLO WATER DISTRICT

STANDARD DRAWING
INSULATING FLANGE KIT

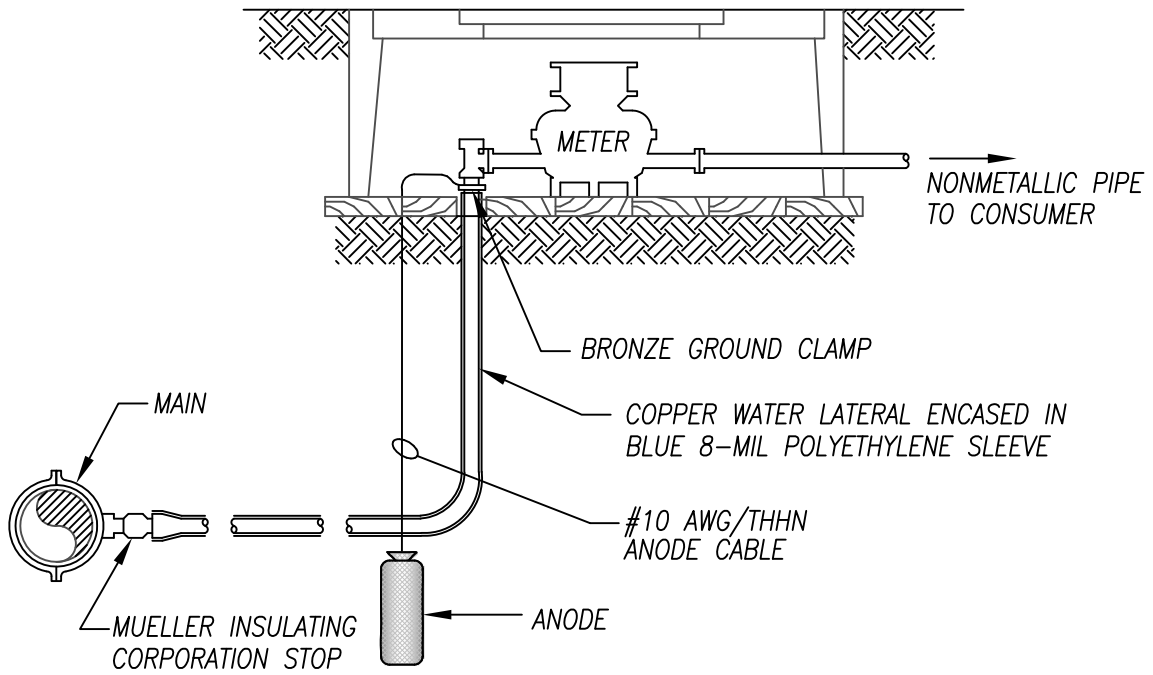
DESIGNED MA

DRAWN SC

APPROVED JDH

DATE DECEMBER 2013

DWG. NO. DWD C23



NOTES:

1. IF WATER MAIN IS METALLIC, PLACE INSULATING COUPLING BETWEEN COPPER WATER LATERAL AND WATER MAIN.
2. MAINTAIN A MINIMUM CLEARANCE OF 2 FEET BETWEEN THE ANODE AND THE LATERAL.
3. TOP OF ANODE SHALL BE 5 FEET MINIMUM FROM THE GROUND SURFACE.

DIABLO WATER DISTRICT

STANDARD DRAWING
COPPER WATER LATERALS

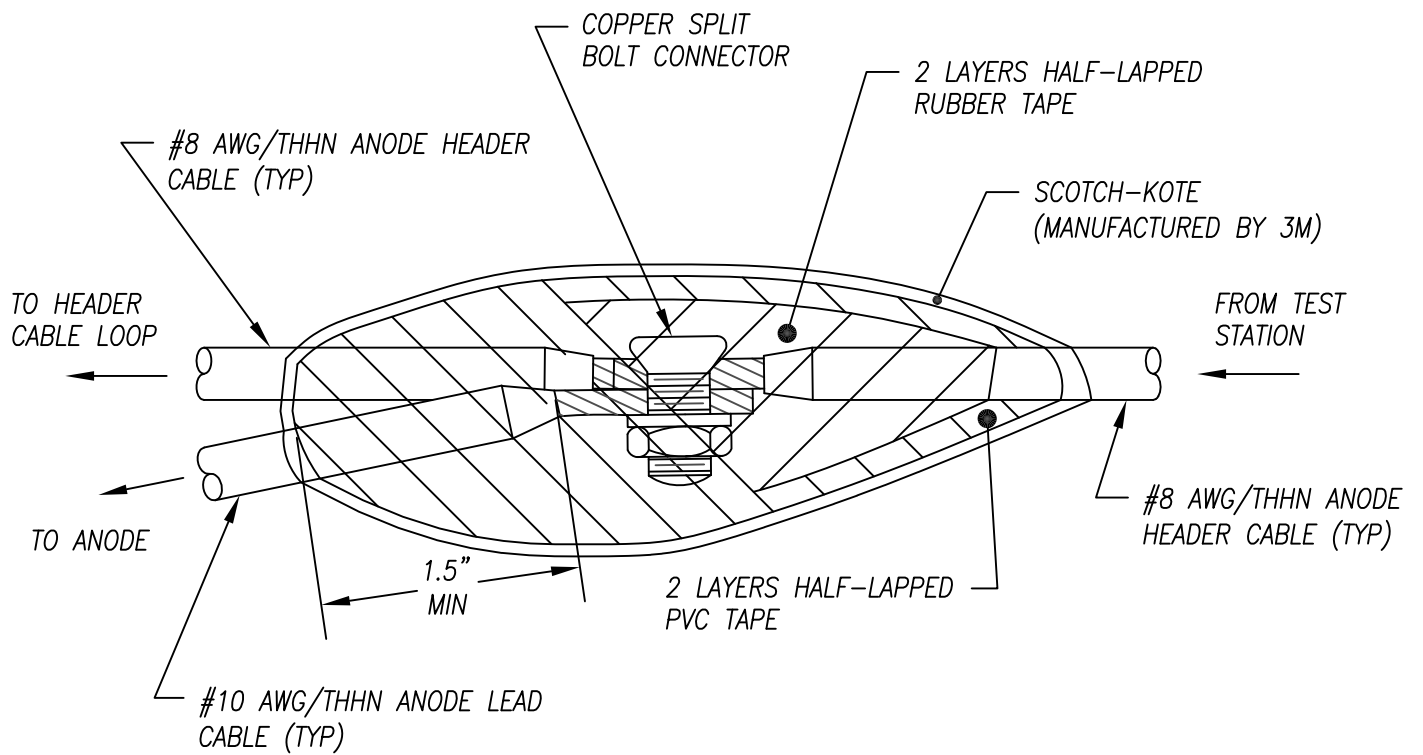
DESIGNED MA

DRAWN SC

APPROVED JDH

DATE DECEMBER 2013

DWG. NO. DWD C24



DIABLO WATER DISTRICT

STANDARD DRAWING
SPLICE DETAIL

DESIGNED

MA

DRAWN

SC

APPROVED

JDH

DATE

DECEMBER 2013

DWG. NO.

DWD C25

**DIABLO WATER DISTRICT
Galvanic Cathodic Protection System Checkout**

Date: _____ Data Sheet No. _____

Job. No. _____ Job Title: _____

System No.: _____ Location: _____

Engr.: _____ Structure: _____

| Station | Anode Potential (mV) | Structure Potential Disconnected (mV) | Structure Potential Connected (mV) | Shift in Potential (mV) | Shunt Measurement (A) |
|----------------|-----------------------------|--|---|--------------------------------|------------------------------|
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DIABLO WATER DISTRICT Impressed Current Cathodic Protection System Checkout

Date: _____ Data Sheet No. _____
 Job. No. _____ Job Title: _____
 Rectifier No. _____ Location: _____
 Engr.: _____ Structure: _____

RECTIFIER DATA:

Input (AC): _____ Volts: _____ Amps: _____
 Phase: _____ Cycles: _____
 Rated Output (DC): _____ Volts: _____ Amps: _____
 Coarse: _____ Fine: _____
 Date Energized: _____

DC OUTPUT:

By Panel Meter: Volts: _____ Amps: _____
 By Volt Meter: Volts: _____ Amps: _____
 Shunt Potential Measured: _____
 Shunt Rating: Amps: _____ per mV: _____
 Current Calculated: _____ Amps

ANODE DATA:

Anode Description: _____ No. _____
 Size: _____ X _____ Long _____ Lbs. _____
 Shunt Rating: _____ mV

| Anode No. | Reading (mV) | Amps |
|-----------|--------------|------|
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| Anode No. | Reading (mV) | Amps |
|-----------|--------------|------|
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**DIABLO WATER DISTRICT
Leak Repair Report**

Date: _____

Data Sheet No. _____

Job. No. _____

Location: _____

Structure Description: Type of Pipe: _____

Pipe Diameter: _____

Year Installed: _____

Internal Lining: _____

Exterior Coating: _____

Polywrap: _____

Cathodic Protection: _____ Yes: _____ No: _____

What Part of the Main was damaged? _____

Describe the Leak: Approximate Size: _____

Orientation on Pipe: _____

Photographs: Yes: _____ No: _____

Describe backfill around pipe: _____

Does damage appear to be mechanical or corrosion related? _____

What type of corrosion damage: _____ No corrosion damage
_____ Pitting
_____ General corrosion
_____ Graphitized cast or ductile iron (looks okay but cuts easily)

If corrosion related, collect soil sample for chemical analysis!

Describe the condition of the pipe adjacent to the failure: _____

Describe repairs made: _____

Materials used: _____